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JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE.

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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THIRD SERIES.

VOL. I.

PHILADELPHIA.

PUBLISHED BY THE FRANKLIN INSTITUTE, AT THEIR HALL.

1841

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JANUARY, 1841.

Address to the Subscribers to the Journal of the Franklin Institute, and to the Public generally.

The Committee on Publications of the Franklin Institute, have determined to commence a New Series of the Journal under their charge, with the beginning of the new year. The January number will, accordingly, be No. I of the Third Series of the Journal of the Franklin Institute.

This change they intend to connect with renewed efforts, as well in the intellectual matter as in the mechanical execution of the Journal.

The valuable papers of the late Chevalier de Gerstner and Mr. Klein, relating to the internal improvements of the United States, will be continued, and the Committee renew their solicitations to American Engineers to contribute the results of their practice to the valuable materials thus furnished to the American public by these distinguished foreigners. One of the most useful British journals contains numerous articles from the daily practice of engineers, which, though short, are interesting as well as valuable, results similar to which must be collected in every summer's work in the field. The Committee are indebted to Thomas U. Walter, Professor of Architecture in the Institute, for the promise of original and selected matter in his interesting department.

The deductions of the Committee on Water Power, from the elaborate series of experiments made by them, and already published in the Journal, will be furnished in this new series, the first part being prepared for the February number. The valuable abstract of patents, with remarks upon them by the Editor, Doctor Thomas P. Jones, will

be continued, as well as the publication of such specifications as appear to merit being given without abridgment. The Committee will endeavour, at the earliest possible date, to procure such notices of the various manufacturing establishments, machine shops, &c. of Philadelphia, as may serve to give an idea of the state of industry in the city, without bringing individual interests into conflict, and would invite the contribution of similar notices from other parts of the Union. They again urge mechanics to contribute practical matters to the journal, and thus to render their knowledge conducive to the general progress of the arts in which they are interested. Besides the view given of the progress of mechanical science by original articles and selections from journals at home and abroad, the Committee are promised notices and abstracts, exhibiting this progress in a more condensed form, by John C. Cresson, Professor of Mechanics of the Institute.

Original articles in chemical and physical science, will, as heretofore, be sought for. As an instructive mode of presenting the condition of particular branches, original essays upon them will be published, and their progress will be recorded by abstracts of the more important investigations in them. The department of general and practical chemistry will be under the charge of Dr. John Griscom, James C. Booth, Professor of chemistry applied to the arts, in the Institute, and John F. Frazer, Professor of general chemistry in the Institute. Translations of interesting articles from the French and German, will be made by Dr. Griscom and Professor Booth. The notices of physical science including astronomy, will be furnished by Professor A. D. Bache, and Sears C. Walker, Esq. The Committee have already incurred a debt to the last named gentleman of obligation for furnishing, in conjunction with Professor Kendall of the Philadelphia High School, the calculations of occultations for several years past. These will still be furnished by the care of these gentlemen from their own calculations or those of Mr. Downes, of Worcester, Mass., whom the Committee are gratified to add to the number of their correspondents.

To improve the mechanical execution of the journal, an entire new fount of type has been provided, by arrangement with the enterprising printer, Mr. Jesper Harding.

These improved arrangements entitle the Committee to ask, from the public generally, and especially from mechanics, an extension of the patronage heretofore given to the journal. The addition of one hundred subscribers to the present list would enable them to support entirely the expenses of the journal, which have heretofore been borne by the Franklin Institute at a small annual loss. Two hundred addi-

tional subscribers would enable them to reduce the price of the journal, which they pledge themselves to do in the event of such an increase to the present list. The object of the Franklin Institute in establishing the journal, was to diffuse knowledge, and not to reap pecuniary profit, and in that spirit the past and present arrangements have been made.

A liberal compensation will be paid, as heretofore, for articles accepted for publication in the journal.

The journal will, in future, be published on the first of every month, the delay in the first number of the new series is unavoidably connected with the arrangements already referred to.

John C. Cresson, Isaac Hays, Samuel V. Merrick, Alex. Dallas Bache, Matthias W. Baldwin, Isaac P. Morris,	Committee on Publication.

Hall of the Franklin Institute of the state of Pennsylvania, for the promotion of the Mechanic Arts.

December, 1840.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

(Continued from Vol. XXVI., page 363.)

Letter VII.

Louisville, Kentucky, June 5, 1839.

The Banking System in the United States.

The Banks have acquired such an extension and importance in the United States, and they are so intimately connected with every thing here, that no day passes without their being an object of conversation in almost every circle, and without observations being made about them in the public press, or Reports of Banks appearing in the papers. One would imagine, that the United States could not exist without banks or without credit, and if you ask, how so many populous, well-built towns have been erected in such a short period; how the im-

penetrable forests in the West have been cleared and cultivated; how the swampy lands on the Mississippi have been transformed into the finest sugar and cotton plantations; how, finally, this general prosperity, which is everywhere visible, has been produced in such a few years; the answer is, "we derive all this from our banking, our credit system; because credit is the first element of the welfare of the Union!"

I once visited a car builder in Philadelphia, who is pretty well known for his ability, but until now did not acquire any property, on account of his expending too much in constantly making experiments for improvements in the construction of rail road cars.

"Are you able to take a large order for rail road cars?" I asked the man. "Yes," replied he," "I can take an order to the amount of $20,000 and more, and require the payment to be made only at the delivery of the cars, in bills at six months." "But how are you able to accomplish this, without being in possession of capital?" "Nothing easier than that. After having made my contract with you, I go to a large timber yard and select what I want in lumber and boards; the timber merchant, on seeing my contract, gives me credit for at least eight months, during which time I fulfil my order. In the same manner, I get the iron, leather, brass, and whatever I want, also on a credit of eight months. I further want cash, to pay my workmen every week, to obtain which, I sell my note, which I get endorsed by one or two friends, to some bank; in this manner I go on with my work, and when I am paid at the delivery of the cars, in bills at six months, I settle my accounts with the lumber merchant and the other individuals, and pay them with the bills I have received. The lumber merchant himself, continued the car builder, has not paid for the whole of his stock; he obtained the timber from the proprietors of forests in the interior, who obtained advances from the banks, when they commenced cutting the timber; it is the same with the iron merchant and all others, who give me credit; they sell me articles which they have not yet paid for themselves, and the first producers have already obtained on their account considerable advances from the banks. This is the course every business takes here; we undertake every thing on credit; whoever has learned a business, and is active and honest, finds credit and money to accomplish every reasonable enterprise. It sometimes happens, that the speculation fails, and the speculator in consequence; he then settles with his creditors, pays them what is left, and commences anew. There are men who have failed four or five times in their lifetime, always recommenced, and again found credit, because they were known to be active and honest; some of them acquire at the end of their life, a considerable property, while others remain poor. The banks and other creditors

easily sustain single losses of this kind, because the mass of their business is so great, that in the whole, they always realize great profits. Thus we proceed in the new world; in the old world, they say, every hing is established upon a solid, durable foundation, and therefore an able and active young man finds no support, if he is deprived of capital; therefore so few undertakings are brought to maturity, as only such, which promise a secure and certain success, are taken up; but experience has shown there, that with all these precautions, they are sometimes found to have made a wrong calculation, and as at the same time the mass of business is proportionally so much smaller, the profits of individuals must be considerably less in the old world, than with us, and the general prosperity of the country must be far less on the increase than in the new world, under an active, industrious, and unprejudiced population, giving each other a mutual support." Such were the words of the car builder; six months have since elapsed; I have almost daily recalled to myself his words, and daily I found new proof of their truth. But the American credit system is such an enormous structure, it is so differently practiced in the twenty-six sovereign States of the Union, and like every other good thing, so much misuse has been made of it, that much time, conversation with well instructed individuals, and mature reflection are required, justly to comprehend the system in its principles, and to judge, how far the same would be practicable for our European institutions. It is the same with this as with the rail road system, the Americans have, in the course of ten years, completed 3000 miles of rail roads, and are always making new alterations and improvements; they have, in the last twenty-five years, established over 700 banks, and in almost every one of them have made some new experiments and amendments. There is no plan of construction of rail roads, there is no system of banking, that has not been tried here, and as the reports of most of the banks as well as of the rail roads, are published annually, we may find here, in regard to banking, instruction not to be obtained in any other part of the globe.

I have had occasion to speak in my last two letters of some banking institutions in the States of Georgia and Louisiana; this letter will contain a short history and description of the American banking system in general, and in my future letters I shall give a more detailed account of the establishment and management of Banks in the different States of the Union.

National Bank, or Bank of the United States.

The Americans had already, while they were English colonists, several banks; but after having made themselves independent of the

English sovereignty, they became more enterprising, wanted more credit, and therefore increased the number of their banks. Every State of the Union granted, at its discretion, bank charters, by which incorporated companies became authorised to issue notes and transact all business connected with banking, within the precincts of the respective States. They soon felt, however, that to obtain an uniform circulating medium, a common central institution was required, and they established in the year 1791, a national bank, called "The Bank of the United States," for which the charter was granted by Congress, and which was therefore recognised throughout the whole Union. The capital of this bank was $10,000,000, of which the general government paid in one-fifth; the term of the charter was twenty years. As most of the banks in the different States (State banks,) had only a capital of some few hundred thousand dollars, the bank of the United States not only did the largest business, but soon acquired a control over all State banks; as soon, namely, as any of these banks brought into circulation too great an amount of notes, or entered into unsafe speculation, the national bank refused its credit, and either did not accept the notes of that institution or sent them to be redeemed in specie. The national bank thereby obtained a powerful influence upon the money matters of the Union, a general complaint about its monopoly arose, and after the expiration of the term of its charter in the year 1811, the latter was not renewed.

In the year 1812 the war commenced between the United States and England; as a natural consequence, credit and enterprise declined, the public rushed to the banks to convert their notes into specie, and the banks were compelled to suspend specie payments. When peace was re-established, in the year 1815, the Union contained over 200 banks, whose notes were, according to the credit of the different institutions, taken at a discount of from 20 to 50 per cent., a great number of private individuals, at the same time, had emitted small notes or obligations, which circulated in the neighbourhood; the whole country was inundated with paper money—gold and silver had entirely disappeared. A plan for a national bank was presented to Congress by Alexander James Dallas, then Secretary of the Treasury, and after a long deliberation in that body, a law was passed in the year 1816, incorporating the second bank of the United States with a charter for twenty years; the capital of this bank was $35,000,000, paid in 350,000 shares, at $100 each, to which the general government again contributed the fifth part. The bank was administered by twenty-five Directors, five of whom were appointed by the federal government; the Directors elected from amongst themselves a President, the latter had a salary, but not the Directors. The principal bank was in Phi-

ladelphia, and twenty-five branch banks were located in the most important commercial places of the Union. The bank had great confidence and credit with the first merchants and bankers in England and France, and was conducted with an ability, which was acknowledged by every one, whether a friend or enemy to the institution.

The federal government employed this bank to receive from the collectors the revenues from duties and from lands sold at the different points of the country; to keep the sums in custody until wanted, and to pay the money out again, wherever it was required; the bank paid all pensions arising from the Revolutionary and late wars, the capital and interest of the national debt; and after the latter was extinguished, had always several millions of dollars of the surplus revenue on deposit. The bank paid no interest to the federal government on the sums confided to her, but at the same time made all the payments required at the different points of the Union, without charging anything for commission. The general government lost in this way the interest on its uninvested revenue, but spared a whole army of treasury officers, saved the cost of transportation, which was considerable twenty years ago, from the want of internal improvements, and finally, as long as it availed itself of the national bank, the general government had not to complain of a single loss, however small.

The confidence of private individuals in this institution was not less; whoever had uninvested capital, deposited the same in the mother bank or one of its twenty-five branches, an account was opened for him, and the bank paid his checks at sight. This was found so convenient, that by and by all capitalists gave to the national bank or one of its branches, or else to another bank, their bills for disbursement, and had all their payments made through the same. The bank did not take any commission for these transactions, but paid no interest on the money deposited. In this manner individuals dispensed with the trouble of exchanging money, which is no easy matter with the mass of different bank notes existing, many of which are often below par; they were relieved of the trouble of making their payments themselves, and finally were not in danger of losing money by thefts or otherwise. Merchants and others find it convenient to continue this course now, and you seldom find, in a counting house or private lodging, $50 in cash, as all the money goes through the hands of the banks.

According to its charter the National Bank could lend to the Federal Government at the most $500,000, and to the governments of the different states only $50,000. The bank issued notes which were received throughout the whole Union by individuals and public officers at par with specie, but were also immediately redeemed in gold or sil-

ver on presentation. The notes of the smallest denomination were of five dollars. The bank discounted bills with two endorsements, payable not later than four months, made advances upon state bonds and other public papers, and purchased and sold gold and silver; according to the charter the bank could not buy and sell public funds, and might possess only such real estate as was mortgaged to them and forfeited in consequence of non-payment. The rate of discount was fixed at 6 per cent. per annum, and as the bank constantly had a large amount of money in its vaults, the dividends on the bank shares usually were only 7 per cent.

The National Bank, which, as above stated, was founded for the second time in the year 1816, commenced business on the 1st of January, 1817, and as early as the 20th of February of the same year, the state banks in the large cities resumed specie payment. Those banks, which could not resume, lost all their credit and had to wind up their affairs. In the year 1819 perfect order was again re-established, and the National Bank had the control over all the state banks. For the second time the cry of monopoly was raised, and when the President of the United States, General Jackson, began to look upon the National Bank as a foreign power in the state, which he could not reconcile with his democratic views, he not only withdrew from the bank, in the year 1834, the moneys deposited by the Federal Government, but also vetoed the bill passed by Congress for the renewal of the bank charter. The bank after having paid over the deposits of the Federal Government, curtailed the discounts, diminished its business operations, and the country was seen to approach a new commercial crisis. After the expiration of the charter of the United States Bank, on the 3d of March, 1836, the banks in the different states recommenced expanding to excess, and a general crisis followed, from which the country is still not quite recovered.

The stockholders of the late National Bank were offered a charter by the State of Pennsylvania, and accepted from that state on the 18th of February, 1836, an act conferring banking privileges for thirty years, under the following provisions: the State of Pennsylvania was to receive as bonus $2,500,000 immediately, and besides, during twenty years, annually $100,000; the bank was to subscribe $675,000 for canals, railroads, and turnpikes; and is finally bound to lend to the state $6,000,000 upon state bonds, bearing 4 per cent. interest, to be taken at par, or upon bonds, bearing 5 per cent. interest, to be taken at 10 per cent. premium. Notwithstanding these heavy conditions, the bank, with a capital of $35,000,000, is very prosperous; and although its notes have legal value only in Pennsylvania, they are accepted in all the other states and often with a premium of one or more per cent.

Banks of the different States.

Bank charters are granted in most of the states of the Union with great liberality; in some of them without further indemnifications, in others for a certain bonus or part of the profit, and generally for a term of from twenty to twenty-five years. The issue of bank notes, and their proportion to the specie is generally left to the discretion of the banks. Most of the banks have a great number of shareholders; there are, however, a few cases, where banks were established by a few individuals. Generally, the legislatures preserve to themselves the right to enquire into the condition of the banks from time to time by commissioners appointed for this purpose; and the banks have to make reports periodically. The President, Cashier, and inferior officers have always salaries, the directors none: a general meeting of the stockholders is held annually, when a report is read to them, and they are made acquainted with the amount of dividends declared by the directors; at this meeting the stockholders elect a new board of directors, and in this manner may exclude from the administration single members or the whole board if they think proper. Such of the banks as appear the most secure are chosen by the Federal Government or the State Governments to receive their deposits and make the payments, as was formerly done by the National Bank.

With this diversity in the banking system, the most diverse results must be presented to us, and as the president and directors of the banks always seek to make the largest possible dividends, it is evident that they embark in a number of speculations, which ought not to be undertaken after mature reflection. Some of the banks possess specie to the amount of 50 per cent. of their issued notes, and therefore readily redeem all the notes presented to them, in gold or silver; other banks have issued three and even twenty times as many notes as the amount of specie in their vaults; whenever a new business offered itself new notes were issued, and when the time of payment came, individuals made new debts; such has been the state of affairs since March, 1836, when the National Bank was discontinued. It became with the banks the same as with the members of a new free colony, where every body is left to himself and may act at his own impulses; disorder and finally anarchy must be the natural consequences. On the 3d of March, 1836, the National Bank, until that time the head of the monied institutions of the Union, was discontinued, and already on the 10th of May, 1837, all the banks in the city of New York by mutual agreement stopped payments in gold and silver; a few weeks after, the other banks in the Union had to follow the same course, and it was not until the latter part of 1838 that specie payment was again resumed. The contest, about the establishment of a National Bank

for the third time, still continues, and has occupied Congress in its last session. The Democratic party, as it is styled here, appeals to the farmers and mechanics, as the most numerous part of the population of the United States, and reminds them of the losses they sustained by the frequent bank failures and suspensions of specie payments, while the opposite, or Whig party, repeats to the same farmers and mechanics, that the banks advanced the money for the purchase and improvements of the lands, which otherwise would have remained profitless; that the enterprising working man obtains money from the banks or credit from the merchant; that finally, the mason, the carpenter and every other mechanic owe it to the credit system, that their wages rose to two and three dollars per day; that, therefore, the banks, numerous and extensive, are indispensable to the welfare of the Union, and a National Bank of the highest importance to the same. The coming Presidential election will decide which of the two parties will obtain the victory.

Number and operations of the Banks in the United States.

To give a clearer view of the extent and operations of the banks in this country, I communicate an extract from two reports, made to Congress by the Secretary of the Treasury, one on the 8th of January, and the other on the 7th of June, 1838.

Date.	No. of banks without branches.	Banking capital.	Amount of deposits.	Notes in circulation.	Amount of loans and discounts.	Specie on hand.
		Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
1st. Jan., 1811	89	52,601,601		28,100,000		15,400,000
Do. 1815	208	82,259,590		45,500,000		17,000,000
Do. 1816	246	89,822,422		68,000,000		19,000,000
Do. 1820	308	137,110,611	35,950,470	44,863,344		19,820,240
Do. 1830	330	145,192,268	55,559,928	61,323,898	200,451,214	22,114,917
Do. 1834	506	200,005,944	75,666,986	94 839,570	324,119,499	
Do. 1835	558	231,250,337	83,081,365	103,692,495	365,163,834	43,937,625
Do. 1836	567	251,875,292	115,104,440	140,301,038	457,506,080	40,019,594
Do. 1837	634	290,772,091	127,397,185	149,185,890	525,115,702	37,915,340
Do. 1838	675	317,636,778	84,691,184	116,138,910	485,631,867	35,184,112

Since the 1st of January, 1838, the number of banks has again increased, and their capital may now amount to not less than three hundred and fifty millions of dollars.

What an immense difference between this enormous capital and the insignificent one, which the few banks upon the continent of Europe, and especially in Germany, are in possession of. The Austrian Empire has now 34,000,000 of industrious inhabitants, and shall a single bank suffice for this immense country from the frontier of Russia down

to Dalmatia? Shall a single bank animate its commerce, make its industry and manufactures prosper, and elevate its agriculture? How much good could be effected, how much could the prosperity of the empire be increased, if at present, when the charter of the bank* expires, a separate bank were established at least in each of the provinces comprising that large Empire, headed by a great National, or Central Bank, and if their statutes were founded upon the extensive experience hitherto made in banking in Europe and in America.

To be continued.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Architecture.

A taste for architecture is not only an evidence of refinement and mental cultivation, but it affords a prolific source of enjoyment; a knowledge of the arts is one of the most desirable accomplishments of life.

Architectural objects are constantly before us whichever way we turn, and new buildings are continually springing into existence in every part of the country. Hence, if a taste for this useful, as well as polite, art, was generally cultivated, its beneficial influences would be co-extensive with the objects it creates, and all the buildings required for the comforts and conveniences of life would consitute so many sources of enjoyment; while at the same time they would embellish the country, elevate the standard of civilization, and throw an imperishable lustre around the national character.

In view, therefore, of the good to be derived from a diffusion of knowledge in architecture, some allusion will be made to this important subject in each succeeding number of the Journal, and such articles will be selected from time to time from the pages of other publications as may tend to promote so desirable an object.

Porticoes.—The similarity which exists in modern adaptations of columnar architecture is as adverse to the spirit of classic art as it is tiresome and monotonous in its effect. A portico is now considered almost indispensable to a design, and the orthodoxy of architects in matters of taste seems to be estimated wholly by the accuracy with which *orders*, and even whole *temples* are copied from the antique.

We often find laboured imitations of the Parthenon, the Theseum, the Erechtheum, and other relics of Grecian genius, executed in situations which not only degrade the beautiful originals, but betray a deplorable want of taste even in adaptation; and yet these "classic models," no matter how absurd their application may be, are tolerated and even justified, on the ground of "*authority.*"

* The National Bank at Vienna.

The popular idea that to design a building in Grecian taste is nothing more than to copy a Grecian building, is altogether erroneous;—even the Greeks themselves never made two buildings alike, nor had they any fixed rules for proportioning the details of either of their orders,—they observed a uniformity of principle,—a correspondence of expression; but always without imposing any fetters on genius other than the limits that nature herself has drawn.

A portico may therefore be designed in Greek taste without being exactly like any thing that ever existed in Greece; it may possess the spirit and beauty of Grecian compositions and yet be different in its disposition, as well as in its details.

If architects would oftener aim to *think* as the Greeks thought, than to *do* as the Greeks did, our columnar architecture would possess a higher degree of originality, and its character and expression would gradually become conformed to the local circumstances of the country, and the republican spirit of its institutions. T. U. W.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Unalterable Blanks.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination Unalterable Blanks, made by BENNERS & DAINTY, of Philadelphia, Penn.: REPORT,

That, the basis of the ink employed is of such a nature that the ordinary bleaching agents, employed to remove writing made on them with ordinary ink, will at the same time remove the basis on which the writing occurs, thereby rendering it difficult or almost impossible to remove or alter the amounts specified without so altering the basis as to destroy or change it in such a manner that the fraud may be detected.

The principle of the method is not novel, but it appears that the basis of the ink they employ is more easily effaced than that of ordinary checks. It should be observed that the above remarks refer to writing made with ordinary ink, and that the blue ink may be effaced without materially affecting the basis written on.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

Philadelphia, Dec. 10, 1840.

Report on an "Improvement in the Apparatus for generating Steam."

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an "Improvement in the apparatus for generating Steam," by PHINEAS BENNET, of New York, present the following REPORT IN PART—

The first essential part of Mr. Bennet's plan is the employment of a close or air-tight furnace, within which the combustion of the fuel is effected. For this purpose, the air which feeds the fire is introduced into it through tubes, under a great degree of pressure, by means of blowing-cylinders or other competent apparatus, worked by the power of the engine; a part of the air entering below the grate-bars so as to pass through the fuel, and a part entering near the upper surface of the fire so as to cause the entire combustion of the smoke. The ash-pit is made close, but may be temporarily opened, by a valve or cock, to remove the ashes. The fuel (which is oak or hickory wood) is introduced through a vertical iron cylinder over the furnace, which has two steam-tight partitions sliding across it, so as to include a chamber between them. When the upper slide alone is opened, the fuel can be introduced into the chamber; and, when this is closed and the lower slide opened, the fuel falls into the fire, which is thus fed, without an opening into the external air.

The close cylinder in which the fire is thus maintained is surrounded by the boiler, whether it be vertical or horizontal, and is always enveloped by water. The gaseous products of the combustion pass from the fire-chamber through a cylindrical collar, or pipe, at the top, which rises through the water into the steam. Over this collar is suspended an inverted cylindrical box, the edges of which enter to a small depth into the water—the whole arrangement constituting what is called a cap-valve. In this way, the heated gases from the fire pass partially through the water, and assist in the generation of the steam.

The steam and gases now pass together into the cylinder of the engine, and operate conjointly upon the piston by their elastic power.

In this brief description many details are necessarily omitted—such as the arrangement for kindling the fire, &c., but it includes all that may be considered characteristic of the apparatus.

Three questions now present themselves for the consideration of the committee. The first has regard to the originality of the plan, the second to its efficiency, the third to the true principles on which it operates.

As to the originality of the plan, the committee are constrained to say, that the claims are very slender.

In a work entitled "The Abortion of the Young Engineer's Guide," published in Philadelphia in 1805, our ingenious and celebrated countryman, *Oliver Evans*, describes, under the name of "The Volcanic Steam Engine," what must be considered as the first conception of all the instruments of this class. The book is now so rare, and the description so full of interest, that the committee deem it proper to copy the whole article on the subject, which is as follows:—"In our pursuit of means to prevent the loss of the heat which is carried up the chimney of the furnace, let us have recourse to the works of nature. View the natural volcanoes, where the fire burns without the aid of atmospheric air; where all the elastic fluid generated by the fire dissolving the fuel, and all the steam formed by the water that may occasionally come in contact with the fire, united, form the most terrible and powerful of all steam engines; in which the furnace, boiler, and working cylinder are united in one, working on the simple principle of applying great elastic power; casting up mountains, and making the earth quake, as she brings her strokes. To apply these principles as far as we can, we make a cylindric boiler, about thirty-six inches diameter, eight or ten feet high, with a furnace inside of it eighteen or nineteen inches diameter. Both the boiler and furnace are united to the same heads, the fire being inside of the water, and the smoke flue turned downwards through the water to the bottom, where the smoke is vented and rises in many streams of small bubbles, that it may impart all its heat to the water to generate steam. The elastic fluid generated by the combustion of the fuel, which we may suppose is two thousand times the bulk of the fuel, and the air used to kindle the fire, expanded by the heat to double its original bulk, unite with the increased quantity of steam to work the engine with great elastic power. But until we can discover a fuel that will burn without the aid of atmospheric air, or until we can find means for kindling the fire with a blast of highly rarified steam, as may be the case in volcanoes, we use a forcing air-pump to force in air to kindle the fire. This form of engine will work with much less fuel, and be much lighter, than any other. It would therefore be more suitable for boats or land carriages, &c. I made a small boiler on this principle, which operated favourably; but being weary of the trouble and expense of putting new principles into practice, I declined the pursuit, until better prospects open, or a more favourable opportunity offers."

In 1824, and subsequently in 1828, *Mr. Samuel Hall* took out a patent in England, for a scheme, (figured and described in volume xii. of the London Mechanics' Magazine,) which agrees with Mr. Bennet's, in using a close furnace, in urging the fire by an artificial blast, in surrounding the fire-chamber by the boiler, and in conveying

the steam and the gaseous products of the combustion, together, into the cylinder of the engine. This inventor, however, did not pass the gas through the water, and, for some motive, caused part of the steam to pass through the fire. He also made use of two furnaces and two boilers, in order that "while one was being replenished with fuel, the other might, at the same time, be employed in the generation of vapour."

In the Mechanics' Magazine, for December 1829, *Mr. William Gilman* gives a description of an apparatus, illustrated by figures, which may be considered a modification of Hall's, but which much more closely resembles that of Mr. Bennet. A single close furnace is used, surrounded by the boiler; the fire is urged by a blast introduced both below and above the fuel; a regular supply of fuel is dropped in from the top; the gases from the combustion are made to pass through the water so as to aid in generating the steam; and lastly, the steam and hot gases pass together into the cylinder of the engine. The identity of this apparatus with that of Mr. Bennet is therefore perfect as to principle; nor is there any material difference in the mechanical arrangements. Mr. Gilman does not, indeed, describe his method of supplying the fire with fuel, and the contrivance used by Mr. Bennet forms one of the claims in his patent. But *Lord Cochran and Mr. Galloway* took out a patent, in 1818, for a steam engine, in which an air-tight furnace urged by a blast was used, and where the method of supplying fuel to the fire was the same as that adopted by Mr. Bennet, except as to the kind of movable partitions employed—a point admitting of great variety. The only real peculiarity in Mr. Bennet's arrangement seems to consist in the cap-valve, to which he lays special claim. It cannot be supposed, however, that an ingenious mechanic would meet with much difficulty in substituting for it some other valve equally advantageous.

While the committee thus fulfil their duty in presenting the whole truth as to the defect of originality in Mr. Bennet's plan, it gives them pleasure to state that he appears to have a just claim to the merit of being the first to carry this plan into successful operation. If Hall's engine was ever tried, its being abandoned shows that it must have failed. The correspondence in the Mechanics' Magazine, on the subject of Gilman's plan, renders it highly probable that his engine was never constructed at all, notwithstanding his assertions to the contrary. If then this novel arrangement possesses the advantages which are claimed for it, the community is indebted for them to the enterprise, perseverance, and skill of Mr. Bennet.

An opportunity of seeing the new engine in operation has not yet been given to the committee, but is promised by the gentleman interest-

ed in the project. When this personal examination shall be made, the committee will complete their report, so as to include the remaining points presented for their inquiry. The evidences given as to the saving of fuel in Mr. Bennet's engine are of the most extraordinary character, and make it a matter of public interest that the facts should be exhibited to an impartial tribunal.

By order of the Board.

WILLIAM HAMILTON, Actuary.

Philadelphia, Oct. 1st, 1840.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1839.

With Remarks and Exemplifications by the Editor.

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1. For a Wooden or Frame Bridge, denominated *The Suspension Bridge;* Stephen H. Long, Col. U. S. E., November 7.
(See specification, vol. xxiv. p. 325, 2nd series.)

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2. For a Wooden or Frame Bridge, denominated *The Brace Bridge;* Stephen H. Long, Col. U. S. E., November 7.
(See specification, vol. xxiv. p. 328, 2nd series.)

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3. For improvements in *Coaches, and other Carriages;* Thomas Shriver, Cumberland, Allegheny county, Maryland, November 7.

There is too much complexity in the apparatus described in the specification of this patent, to admit of verbal description, the drawings contain twenty-two separate figures, and some of them with numerous references. The following are the claims.

"*First.* The extension of the perches beyond the jack bars and axles. The mode of staying the jacks outside, in vehicles of every description on rail roads, or common roads, in the manner herein described, or in any other substantially the same. The mode of supporting the tongue by a slider, or sway bar, in front of the axle tree. The plan of bending the side perches inwards, better adapted for light vehicles on roads, &c.; and the mode of stocking the axle trees, and arching them upwards, as described. I also claim the brake acting against the road; or if a rail road against the horse path, or rails, by means of the above, or any other mode substantially the same, and the window-bearing, turning on its centre, whether circular, or other shape, operating as herein described, or in any other manner substantially the same."

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4. For *Blue Writing Fluid;* Henry King, city of Baltimore, Maryland, November 9.
(See specification.)

5. For *Coupling Two or More Ploughs;* to be worked by one team; Joseph Card, Painsville, and Grandison Newell, Mentor, Geauga county, Ohio, November 9.

"The nature of our invention consists in attaching to the draught end of the plough beam, a coupling case of such length as is desired, according to the number of ploughs to be worked at once, and so constructed as that each plough shall run truly, steadily, and at any given distance from its fellow."

The claim is to "the mode of drawing one, and of coupling two or more ploughs together, by means of the case, stirrups, and bolts, as described."

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6. For a *Bee House, or Hive;* John Schole, city of New York, November 9.

This Hive, or House, is very ingeniously contrived, so as to present the advantages sought for in a simple and economical manner. The outer case, or body of the hive, is an ordinary flour barrel, and within this there are placed a number of boxes, made of very thin pine boards, joined together in the rough, and in such form as to fill up the capacity of the barrel, and to be readily removed when full, and their places supplied by others. We shall not attempt a description of the manner of establishing the requisite communication between the respective parts, with the valves and other appendages, which are all arranged with a view to utility and economy. They have been long on sale in New York, and are now well known.

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7. For a *Road and Street Gauge;* Randal Fish, city of New York, November 9.

This is an apparatus intended to grade and gauge the surface of the ground in streets and roads, made, however, with a particular view to preparing streets for the reception of wooden blocks. It consists mainly of four pedestals to be placed two on each side, or on the side or middle of the road, and which support longitudinal or string pieces of board, which are attached to the pedestals, so that they may be adjusted to the required level, or inclination; and of a cross piece, the ends of which rest on the string pieces, whilst a gauge board descends from it, which may have its lower edge concave, so as to give the crowning form, in any required degree. By moving this along the string pieces, the grading may be perfectly regulated.

"What I claim is the manner in which I have arranged the three parts, as set forth, so as to adapt them by such combination and arrangement to the attainment of the end for which it is constructed. That is to say, I claim the combining of the side pieces, and the mode adjustable as set forth; with the grading gauge, and with the provisions for adjusting the same. It will be manifest that this instrument may be varied in some particular points, and yet remain substantially the same in its general structure and use; its essential features being its general capability of adjustment, as pointed out, so that by drawing

along that part denominated the grading gauge, its lower edge shall show the precise height, or line, of the surface of the road.

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8. For machinery for *Manufacturing Long Cordage;* William E. Meginnis, city of Philadelphia, November 9.

"The nature of my invention consists in a machine for manufacturing cordage by confining the strand, or rope, firmly in the end of the horizontal spindle that imparts the twist, and after twisting the rope, or a component part thereof, the length of the rope walk, the rope is loosened at the outer end of the spindle, and the operation of twisting is repeated. By this arrangement, ropes of great length, many times the length of the rope-walk, can be manufactured, and thus avoid splicing."

The claim is to "the making the head of the spindle in two parts, which can be separated for the purpose of putting in and taking out the rope, &c., or scarped out for the same purpose, as described."

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9. For an improved manufacture of *Cotton Twine, or Cord;* Jacob Sloat, Strasburg, Rockland county, New York, November 9. (See specification.)

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10. For an instrument for *Measuring, for Cutting Garments;* John P. Barnett, and Francis Story, Cattskill, Greene county, New York, November 12.

This instrument, like many others for the same purpose, consists of elastic strips of metal, duly graduated into inches, and parts, and furnished with sliding and fixed strips carrying measuring tapes, by the use of which it appears likely that all the measurements required by the cutter can be correctly taken. The claims refer by letters to the respective parts supposed to be new.

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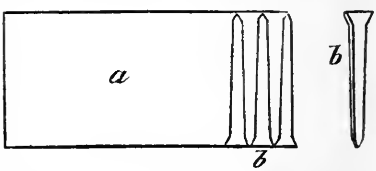
11. For an improvement in *Cut Nails and Brads, and in the Machinery for Manufacturing the same;* Walter Hunt, city of New York, November 12.

"The improvement in the form of said nails, brads, &c., consists in their being cut from hoops or plates of iron, with blunt, wedge shaped, points, and dove-tail, or wedge-shaped heads," as shown in the margin where *a* is a nail plate, and *b*, *b*, the nails. It will be seen that these nails do not require heading, they being cut with a projection on each side, forming what may be called a double brad head.



The cutting is effected by cutters, which are segments of cylinders made to vibrate on their axis; and so far as we can judge from the model, and from the nails and brads cut by the machine, its operation

appears to be perfect, whilst its construction and arrangement are such as to promise durability.

The claim is to "the making the two sides of the head of one nail out of the metal left by cutting the wedge-shaped points of the nails on each side as herein above described; and this I claim whether effected by the above described machine, or any other. Also in the machine above described I claim the shifting of the bed cutters for the purpose and in the manner set forth."

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12. For a *Cooking Stove;* Ebenezer Ferren, Haverhill, Grafton county, New Hampshire, November 12.

This stove appears to be well arranged for governing and directing the draught by means of dampers, and other devices connected therewith, the particulars of which it is not deemed necessary to set forth, and they could not be clearly described without the drawings. In its general form and construction this stove resembles numerous others, in common use.

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13. For a *Straw Cutter;* William A. Staples, Lynchburg, Campbell county, Virginia, November 16.

In this machine there are two knives, or cutters, placed upon the end of a horizontal shaft, which is made to revolve alongside the feeding trough containing the straw. These knives revolve between double rims or circular plates of metal which are sustained at a sufficient distance apart for that purpose. The claim is to "the employment of the double rims, between which the ends of the knife, or knives, are received and revolve, said rims being furnished with cross-bars, which operate as stationary, or bed, shears, sustaining the straw on each side as it is cut by the knife."

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14. For *Scales for Weighing;* George White, Louisville, Jefferson county, Kentucky, November 16.

These scales are to be combined with a counter, above which the dishes, or platforms, for containing the weights, and the articles to be weighed, are to stand; the parts which operate as a beam being within the counter. The claim is to "the method of adjusting the vertical support for the scales by means of the arrangement of the screws, nuts, and loops, as set forth; and the method of raising or lowering the fulcrum and beam so as to bring the scales close to the counter, and out of the way of creating any obstruction by the use of the same." In this arrangement there is not any thing worthy of special description.

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15. For a machine for *Turning the Heads of Wooden Screws and Rivets;* Henry Crum, Clarkstown, Rockland county, New York, November 16.

This machine is necessarily complex, requiring to have its respective parts fully exhibited by drawings, to make their action known. A principal feature of novelty in it is what is denominated the feed

wheel, which consists of a rim projecting out at right angles from a circular disk, or head. This rim is perforated to receive the shanks of the screws, which are fed in within the rim. The holes are countersunk to adapt them to the undersides of the screw heads, and these countersunks are formed in steel plates, and groved so as to constitute cutters. The shanks are received in a clamp chuck, on the end of a lathe spindle, or revolving mandrel, on the outside of the wheel; this spindle being forced back by a sway bar, causes the under side of the heads to be borne against the countersunk cutters; and at the same time a tool is brought up against the top of the screw head, and turns it. All the parts of the machine are self acting, with the exception of the putting the screws to be turned into the feed holes in the wheel, by hand. There are a number of ingenious devices about this machine, some of which resemble, very closely, those employed in that for cutting wood screws, invented and patented by the same gentleman.

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16. For an improvement in *Friction Matches;* John H. Stevens, city of New York, November 16.

The claim under this patent is to the preserving of the matches from accidental ignition by covering them with a coating of varnish, as set forth. Various substances, it is said, may be used for this purpose, but what is used in general "is a little solution of gum mastic, made with spirits of turpentine; or of an alcoholic solution of gum copal or of gum mastic; but other glutinous gums, resins, tenaceous matter, or compounds may be used," &c.

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17. For forming the ignitable matter of *Friction Matches;* John H. Stevens, city of New York, November 16.

The claim is to "the combination of litharge, and the red oxide of lead, or either of them separately, with carbonate of lead, phosphorus, and any glutinous or viscid material on which the preparations of lead will produce a drying effect, and thus render the said compound harder and more durable, retaining its specific character for a longer period than any other compound analogous thereto, and designed for the alike purposes of ignition, all as described."

"I also claim the combination of litharge and red lead, or either of them separately, with the black oxide of manganese, phosphorus, and a glutinous or viscid material on which the preparation of lead will produce a drying or hardening effect, substantially as described."

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18. For improvements in *Friction Matches;* John H. Stevens, city of New York, November 16.

"The nature of my invention consists in dispensing with sulphur, which is employed in the ordinary wood matches or friction lights, to make them more ignitable; and using in lieu of it, nitre or salt petre, by which means the match is not only ignited, but the unpleasant smell of the sulphur is avoided, while at the same time the match being

saturated with the nitre, is converted into a slow match, and continues to burn until consumed. The said matches I call Stevens' fusee segar lights."

The splints are to be soaked in a solution of salt petre, dried, and dipped into the phosphoric composition. The claim is to the combination of the wood so saturated and dried, with any of the suitable phosphoric compounds.

We should offer some animadversions upon the foregoing patents, but believe that the question of the validity of some of the claims is now a subject of legal investigation, and therefore we, at present, leave them to the proper tribunal.

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19. For a *Steam Boiler;* John C. F. Saloman, Shelbyville, Shelby county, Kentucky, November 16.

The patentee of the foregoing boiler obtained a patent on the 17th day of Oct., 1835, for an inverted arch steam boiler, which was, as we believe, constructed upon false principles, and in the *improved* form now given to his boiler, he has carried the same principles to a much greater extent. The plan would require only to be seen by any intelligent practical man to insure its unqualified condemnation. The claim will not lead to a knowledge of the arrangement of its respective parts, and it would waste too much time and paper were we to attempt a description of it. We wish for the sake of the inventor, who appeared to be a gentleman of much cleverness, that the patience and perseverance which he has displayed against numerous obstacles, had been directed to the attainment of some object of utility, and about which he knew something more of first principles. We will merely add, that he uses his inverted arch boiler, and to the junction of each of his arches he attaches a cylindrical boiler, extending from end to end of his main boiler. These are represented as nine in number, and we suppose are to operate as abutments to his arches; these form what the patentee calls a "*nine sided plane cylinder!*"

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20. For improvements in *Cooking Stoves with Elevated Ovens;* John P. Williston and Willard A. Arnold, Northampton, Hampshire county, Massachusetts, November 16.

In this specification there is described a manner of dividing the flue which leads from the fire chamber to the stove pipe, immediately under the top plate of the stove, into three separate flues furnished with dampers, or valves, "for the purpose of directing the draught under either or both of the upper boilers," but this mode of dividing the flues and directing the draught is not claimed, the claim being confined to the manner in which they have combined an elevated oven with a stove, by carrying the heated air compartment entirely across the back end of the stove and allowing the flues from the elevated oven to open into this compartment; by which means the perfect action of the oven is secured although the draught may be directed under one of the upper boilers only.

21. For an improved *Spark Arrester;* Leonard Phleger, city of Philadelphia, November 25.

This spark arrester has been superseded by one since invented by Mr. Phleger, who has, we believe, abandoned that which was the subject of the above named patent. We shall, therefore, let this go among the unsuccessful attempts to accomplish an important object; and should that now used by Mr. P. continue to sustain its present reputation, we will publish the specification, with drawings of the apparatus.

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22. For *Preventing the dragging of Ships' Anchors;* Russel Evarts, New Haven county, Connecticut, November 25.

"My machine consists of a weight of iron or other metal, called a sinker; the base being square, and the height about twice as great as the breadth of the base. In its top is a semi-circle to receive the chain or cable; near the top is a hole to receive a bolt which is to fasten a clasp to the sinker. There are also two rings below the bolt hole, and above the centre, of the sinker."

We were about to furnish the description given by the patentee, to a greater extent than the foregoing, but believe that we can render the construction much more clear by a few words of our own. The sinker is a heavy weight, furnished with a bale, or gallows, at its upper end, and containing a friction roller which is to rest on the chain, or cable, and guide it down near to the anchor. This bale is bolted to the sinker, and can be removed for the purpose of placing it upon the cable, when it is to be raised. The weight, laying upon the bottom, will tend to keep the anchor down, and prevent its dragging. It is proposed to use a similar apparatus to be allowed to descend half way to the anchor, so as to give a spring to the chain, or cable, which will tend to prevent its parting, from sudden jerks. The claim is to the construction and employment of the above described apparatus.

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23. For a *Cooking Stove;* Micah Ketchum and W. A. Wheeler, Boston, Massachusetts, November 25.

In this stove there is a box, or grate, within the fire chamber, which is to be raised or lowered by means of racks and pinions under the hearth, which, however, is not a novel feature in stoves; the claim made is very limited, being to a certain movable, dividing plate, in combination with a partition, which combination, not appearing to be of any special importance, we shall pass over.

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24. For machinery for *Boring the Posts and Tenoning the Rails for Fences;* William H. Shay, city of New York, November 25.

"For boring the posts I use two or more augers placed side by side, and geared together so that by communicating motion to one of them the whole will be made to revolve. The parts to be bored are held by means of what I denominate calliper leaves, which are sustained

upon a sliding carriage upon which the post can be fed up to the augers. The tenoning apparatus consists of cutters placed upon a revolving wheel which I denominate the rotary cutter, or tenoning wheel. Said wheel having a double rim, each of which is furnished with a cutter, or cutters, that sharpen, or tenon, the rails, reducing them all to the same thickness at the ends."

The claim made is to "the combination and employment in such a machine, of the calliper leaves for holding the posts whilst they are being bored; by means of which the range of mortars will all be in a direct line, and through the middle of the stuff, notwithstanding any twist, or other irregularity, which there may be in it."

Specifications of American Patents.

Specification of a Patent for a Blue Writing Fluid, granted to Henry King, *city of Baltimore, Maryland, November 9th,* 1839.

To all whom it may concern: Be it known that I, Henry King, of the city of Baltimore, in the state of Maryland, have invented a new and improved mode of manufacturing blue writing fluid; and I do hereby declare that the following is a full and exact description thereof.

To enable others skilled in the art to make and use my invention, I will proceed to describe its composition and operation.

1st. Take Indigo powdered, $2\frac{1}{2}$ ounces.
" Sulphuric acid 1 lb.

Mix, and stir with a glass rod, occasionally, until the indigo is dissolved.

2d. Take next	Galls, Aleppo	1 ounce.
"	Alum .	3 dachms.
"	Boiling Water	1 pint.

Mix, and let stand twenty-four hours or till the precipitate falls, then filter.

Take mixture first, put it in a glass, or stone, vessel, add sixteen ounces of water. Then gradually add carbonate of lime four pounds, or a sufficient quantity to neutralize the acid, then add seven pints of water, pour off and filter; then add mixture second, and to each ounce of the fluid add one grain of sulphate of iron.

To manufacture the changeable blue writing fluid: take one gallon of the blue fluid already prepared, and add to it No. 2, then to each ounce add nine grains of sulphate of iron, and filter.

What I claim as my invention, and desire to secure by letters patent, is the combination of the ingredients herein specified, so as to form a blue writing fluid, the same being combined in the manner set forth.

Henry King.

Specifications of English Patents.

Specification of a Patent granted to Goldsworthy Gurney, *of the county of Cornwall, and* Frederick Rixon, *of the county of Middlesex, for their invention of improvements in the apparatus for producing and distributing light.—[Sealed 8th June,* 1839.]

This invention of improvements in the apparatus for producing and distributing light, is applicable to lamps or burners, wherein oil or oleaginous matters, in a liquid state, are the materials consumed for producing the illumination; and our improvements also apply to various kinds of lamps, burners, or lights, wherein the inflammable gas or vapour obtained by the distillation of coal, oil, rosin, asphaltum, or other bituminous, resinous, or oleaginous matters is used, as the material for illumination; such gases or vapours being previously obtained, and then conveyed to the lamps or burners by pipes from a reservoir or gasometer; and consist, in the first place, in improved arrangements and constructions of conducting pipes or tubes and cocks, and jets or burners, whereby we are enabled to introduce into the interior of the flame of such lamps or burners, a stream or jet of pure oxygen gas. The atmosphere or atmospheric air being carefully excluded therefrom, that is, from passing through the burner, or into the interior of the flame. This jet or stream of pure oxygen is applied or given to the flame for the purpose of producing a more intense ignition of the carbonaceous matters, and consequently a more brilliant light than can be obtained where atmospheric air alone, or a mixture of atmospheric air and inflammable gases, are used to cause combustion.

It may be proper here to remark, that we are perfectly well aware that mixtures of air and inflammable gases have been applied to flame for the increased production of heat, and in certain cases to produce light, (in a peculiar description of lamp) which lamps burn the vapour or gas arising from the liquids contained within themselves; we therefore wish it to be distinctly understood, that our improvements have nothing whatever to do with such mixtures of atmospheric air and inflammable gases.

And we are also aware, that pure oxygen has been applied to hydrogen gas for the purpose of producing intense heat for blow-pipe purposes, and on lime for producing light; we therefore desire it to be understood, that our invention only applies to administering to the flames of oil or gas lamps, or burners, a jet or stream of pure oxygen, which, of itself, is not inflammable; but, when applied to the flame in the manner hereinafter described, and at the proper place, will produce intense or bright and clear light, which is caused by the oxygen or supporter coming into contact with the combustible bodies or inflammable gases, at the point of ignition. Therefore, as regards our invention, this jet or stream of pure oxygen may be called the source or cause of the extra light given out; and we have, therefore, in contra-distinction to all other lights, called this "The Olio-oxygen, or Bude Light."

And secondly, our improvements consist in the application and use of peculiar and novel constructions and arrangements of apparatus, whereby flashing or intermitting lights may be caused, or produced, and used as signals for locomotive steam-engines or carriages, and steam or other vessels, or in other situations where they may be required; such intermitting or flashing lights being caused or brought into operation by the passage of streams or bubbles of pure oxygen through flame, when brought in connection therewith, or of inflammable gases when burnt alone without the jet or stream of pure oxygen, such bubbles of inflammable gas being ignited by a small stationary and continuous light; the bubbles of gases being produced by their passing through an inverted syphon, containing liquid, acting as an hydraulic valve. Or the same effect may be caused by the actuating power of machinery or an engine, and may therefore be made capable of indicating the speed at which a locomotive engine or steam vessel is traveling, by the rapidity with which the flashes are repeated.

This effect may be produced by any proper arrangements of mechanism depending on the revolution of the wheels, or the strokes of the engines, or other moving part of the machinery; or in the former case by increasing or diminishing the column of liquid in the inverted syphon, and thus causing a greater or less resistance to the passage of the gas. The same effect may also be produced by altering the capacity of the gas and water tubes, and thereby causing a quicker or slower pulsation of the light.

The construction of the lamp requires two supply pipes—one of which may lead from the street main, or supply gas pipe, gasometer, or oil or gas reservoir, or other source, as the case may be, and the other is the pipe through which the pure oxygen or non-inflammable gas is to pass, or be conducted to the jet or burner,—this pipe may lead from any suitable apparatus for obtaining the pure oxygen, or from a reservoir containing that gas.

The oxygen pipe is connected by an air-tight joint to the lower part of the burner or jet, and passes up the interior thereof, its mouth or exit aperture being on a level, or a little below that of the burner or surrounding flame.

Both of the pipes where inflammable gas is used, must be furnished with stop-cocks, to cut off or supply the two distinct gases. These cocks may be placed separately on the pipes, or they may be constructed with one plug, serving for both pipes, they being connected by air-tight joints to the separate channels. The plug has two apertures bored through it, which are opposite, and answer to the separate channels. The bore of these apertures should be somewhat smaller than that of the passages to allow for wear in the parts, or tightening down the plug.

It is desirable that the apertures should be so arranged, that the oxygen may be let on a little before the inflammable gas, and also shut off a little after it. This is readily done by making the apertures for the inflammable gas, a little smaller than the other.

It is requisite, in order to carry this part of our improvements into proper effect, that the two streams or jets of inflammable gas, and pure

oxygen or supporter, should flow in proper proportions one to the other, therefore the pipes or channels, must be furnished with regulating cocks, or set screw plugs, by which their capacity, or the passage of the gases through them, shall be determined.

When oil, in the fluid state, is consumed for illumination, the pipe or tube, leading from the oil reservoir of the lamp to the circular channel within the burner, is made like a common Argand burner, excepting that the bottom part is closed, so that *no* atmospheric air can pass up the interior. The burner is furnished with a cotton wick, and means of adjusting its height, together with a gallery to hold a glass chimney, as usual. The pipe for the passage of the pure oxygen from the reservoir to the flame is passed through the side of the burner by an air-tight joint, and extends upwards within the burner. The oxygen pipe is furnished with a regulator, plug, or stop-cock, and also with the other cock for the purpose of giving the supply of oxygen to the lamp when it is once lighted, and cutting off the same when it is to be put out. A movable cup is screwed air-tight to the bottom of the burner, which serves for the purpose of stopping up the end of the middle channel, and receiving any deposit from the oil or flame.

The pipes, and the cutting off and supply cocks which, in this instance, have their plugs separate from one another, are turned simultaneously by one handle,—the end of one of the plugs being keyed or counter-sunk into a mortice in the other, so that they must move together, although they may be set up or tightened separately, as may be required.

The second part of our invention contains modifications of our improved apparatus for producing flashing or intermittent lights for signal purposes;—these figures will serve to explain this part of our invention.

There are two ways of obtaining or producing this effect; the *one* is by the *simple action* of bubbles or globules of gases passing through liquids; that is, of inflammable gas, when this alone is used to cause the light, and also of the pure oxygen when the flame of other matters is used in conjunction therewith, the bubbles of either the inflammable or non-inflammable gases passing from the supply pipe through an inverted syphon or chamber, containing a column of liquid, which, acting as an hydraulic valve, (the column being displaced before the bubble can pass,) interrupts the passage of the gases through the pipe, and produces pulsation at the burner. The *other* method is to obtain the same effect by mechanical means, by alternately exposing and hiding, or nearly shutting out the light. The effect of this mechanical operation may be obtained by placing a revolving or moving shade around the flame of the lamp, which shade shall hide the light, except at a part desired, say all but through an aperture in the side of the shade. This aperture being furnished with a reflector to throw the light to a distance, and as the shade and reflector revolve around the flame, it will have the appearance or effect of a flashing or intermitting light to any person placed before or behind it; or the same effect may be produced by alternately opening and shutting the door of a darkened lanthorn containing the light.

Another arrangement of mechanism for producing the same effect, is by means of a supply and cutting-off cock or valve, placed in the gas pipe when the inflammable gases are used alone, or the oxygen when used with the flame of other bodies; which cock is to be alternately opened and closed by some suitable connection with the machinery, and by thus alternately supplying to and cutting off the inflammable gas, or the oxygen, as the case may be, from the flame, produce a flashing, interrupted, or intermitting light.

When the inflammable gas is used for this purpose, there must be a small continuous flame in such position that the bubbles of inflammable gas, as they come in contact with it, will catch fire, and the flashing light thereby be produced; and when pure oxygen is used, the flame of the oil or other matters being kept continually alight, its intensity will be increased or diminished as the oxygen is supplied thereto or cut off therefrom.

One arrangement and construction of apparatus, whereby the method of causing the intermitting or flashing light, by interrupting the passage of the gas or oxygen from the reservoir to the burner or flame, is effected, by means of a column of fluid being placed in its way. A gas pipe is connected, air-tight, to the closed chamber or well containing a given quantity of water or oil; a pipe is carried down to near the bottom of the chamber, where its end is turned up, and opens into the inner tube, which serves as a guide for the bubbles as they arise, and determines the time of pulsation, or passage of the bubbles, by its area; or the same may be determined by the height of the column of fluid.

It will be evident, that if the pressure of gases in the reservoir is properly regulated according to the height of the column of water in the chamber, (or vice versa,) the gases will only be able to escape from the descending pipe through the chamber to the burner in bubbles, or only at intervals, or whenever the pressure of the gases has overcome the weight of the column of water, and forced it out of the descending pipe into the chamber, and thus allowing the escape of the gases to the burner only at intervals. There is a pipe, furnished with a funnel and stop-cock, by which liquid can be introduced into the chamber, and a pipe and cock whereby it can be withdrawn.

This interruption of the flow of the gases can be obtained by several other modifications of apparatus, wherein water or oil is opposed to the direct or continuous flow of the gases, the fluid having to be displaced by the force of the gas before it can pass,—the water or oil returning after each portion of gas has effected its escape; therefore it will not be necessary for us to describe all such modifications of the simple apparatus; but we will proceed to describe one or two modifications, or arrangements, or constructions of the mechanical means to be employed to produce this effect.

Another modification of apparatus, consists of a revolving shade or reflector, placed around the flame of the lamp, which will prevent the transmission of light, excepting through the face thereof; and as this reflector turns around the stationary light, it will throw the rays of light in different directions, and by being enclosed in a dark lan-

thorn, with only one face or part open, will have the appearance of an interrupted or flashing light to any person stationed before or behind it. The jet or burner, is fixed in any convenient situation, and is furnished with all the requisite pipes and tubes for oil or gases; a hood or reflector is fastened to the tube which surrounds the burner, and rests on a shoulder or ledge formed upon it. Rotary motion is to be given to this tube and reflector by any convenient mechanism connected with the machinery, as by a band passed from a pulley, or any rotary part of the engine or machinery.

The same effect of flashing or intermitting light, may be produced by alternately opening and closing a door or shutter in a dark lanthorn, enclosing the flame, and may be done by a suitable machine, having an alternate motion from any part of the machinery.

Another mode is to cause the intermitting or flashing to be produced in a stationary lanthorn and continuous light, but in which the supply cock of the oxygen pipe is alternately opened and closed, whereby the intensity of the flame is increased or diminished, as the admission of the oxygen is allowed to pass to, or is cut off from the flame.

An oil lamp, adapted for this purpose, may be furnished with a movable reservoir of oil and cotton wick burner in the ordinary manner, and a pipe or channel for the pure oxygen, leading from a reservoir to the top of the burner into the interior of the flame. The part of this pipe, between the lamp and the cock, may be made either of metal or flexible material, as circumstances may require. A supply and cutting-off cock or valve, in this instance, is intended to have a rotary or interrupted rotary motion given to it by means of the pulley on its plug; but a common slide-valve or cock, alternately opening and closing by means of a reciprocating or alternating motion, obtained from the machinery, may be placed in the same situation, and will produce the same effect. A lamp or lanthorn may be fixed in any required position, and when flexible tubes are used, may be made to take on and off its fittings when required. The seat or bed of the cock or valve is to be fixed in any convenient situation on the locomotive engine or vessel, and a rotary or alternating rotary motion given to it, by means of a band or strap passed to a pulley, from any revolving part of the machinery, or by a toothed rack connected with and actuated by any part of the machinery, which has a regular alternating or reciprocating motion; or the same effect may be produced by an eccentric, connected by a rod to a crank, all of which modifications or arrangements are so well understood, that it is not necessary for us to describe them.

Having now described and ascertained our improvements, and the manner of carrying the same into effect, we wish it to be understood, that we do not intend to confine ourselves to the precise forms, or arrangements of construction of apparatus or mechanism, herein shown, as the same may be varied to suit different circumstances; and we claim as our invention, secured to us by the above in part recited letters patent, as our "improvements in apparatus for producing and distributing light," first, the arrangement and construction of pipes or tubes connected with jets or burners, and furnished with suitable

stop-cocks or valves, whereby a jet or stream of pure oxygen is administered or given to the interior of the flame of either oil-wick or inflammable gas lamps; and, in the second place, we claim, as our improvements in apparatus for producing and distributing light, the improved arrangement and construction of apparatus or mechanism, whereby we are enabled to produce an intermitting, or interrupted, or flashing light, to be used as signal lights for railway, telegraphic, and navigation purposes, either by passing the inflammable gas in bubbles, when it is used in connection with a small fixed continuous light, or the pure oxygen when used in the interior of flame, obtained from the combustion of other matters, the pressure of the gas overcoming a column of fluid, and thereby causing pulsation or passing of bubbles, before it can escape to the burner or flame; and also the improved apparatus or mechanism, whereby we obtain the same effect of intercepting the passage of the gas, either inflammable or non-inflammable, to the fixed or continuous flame, by alternately opening and closing the valves, cocks, or taps of the gas pipes, and thereby causing an intermitting or interrupted light; and also the improved apparatus or mechanism, whereby we obtain the same effect, by the revolving or moving shade or reflector surrounding the light, as hereinbefore described.* Lond. Jour. Arts & Sci.

Specification of a Patent granted to James Horne, *of Clapham Common, Surrey, gentleman, for improvements in the Stuffing Boxes of Lift Pumps.*—[Sealed 3d September, 1839.]

The peculiarity of this invention consists in combining in each stuffing box two cupped leathers inverted, with their bases towards each other, and having between them a flat disc of metal; the flanch of the lower cupped leather rests upon a projecting ledge, cast upon the inside of the stuffing box, and that of the upper cup is forced down by a similar projection in the cup of the stuffing box, in such a manner that, on the rising of the piston rod (which passes through both the leathers, and the metallic disc,) the lower leather will resist the pressure of the fluid from below, and the upper leather that of the atmosphere from above, on the return of the piston rod. Mining Jour.

Specification of a Patent granted to Thomas Farmer, *of Gunnersburg House, near Acton, Middlesex, for improvements in treating Pyrites and other matters, to obtain sulphur, sulphurous acid, and other products.*—[Sealed 25th August, 1839.]

This invention consists in treating pyrites or other substances containing sulphur in a state of combination, and by causing them to burn in a furnace without the aid of fuel, so as to disengage the sulphur which they contain, and form thereby sulphurous acid gas, or sulphur in its simple state. The furnace having been heated in the first instance

* Figures descriptive of the apparatus, are given in Newton's Journal and Repertory, for September 1840.

with coals, or with burning pyrites, is afterwards fed with pyrites introduced in the doorway; and the further advantage of this invention consists in the mode of charging the furnace, regulating the admission of the atmospheric air, and the withdrawing of the decomposed materials.

The furnace has two chambers, one above the other; the doorway of the upper one is in front, and the lower chamber has its doorway behind. The pyrites, with the fuel, is first placed in the upper chamber, and is lighted in the ordinary way, and whatever particles escape through the upper grating, the lower furnace will consume, which residuum is removed when required, and as soon as any pyrites in the upper furnace form into clinkers, such clinkers are removed, and fresh pyrites are thrown on to the burning fuel, which yields its sulphurous acid gas to be passed off through a chimney, or channel, into a chamber, where it is treated as sulphur heretofore.

When it is designed to treat for sulphur, rather than for sulphurous acid gas, the door must be closed entirely, and only sufficient air must be admitted through a vent, in order to support combustion; and to facilitate the sublimation of the sulphur, a vapour of water must be passed from the ashpit to the burning pyrites, which impart their sulphur to be condensed in the ordinary way adopted. Ibid.

Specification of a Patent granted to James Beaumont Neilson, *Glasgow, for certain improved methods of Coating Iron, under various circumstances, to prevent oxidation or corrosion, and for other purposes.*—[Sealed 29th August, 1839.]

The inventor claims the method of coating or covering iron, &c., by means of copper, or alloys of copper, with zinc or tin. The copper or alloy is brought to that minute state of division in which it is obtained by precipitation from its solution, or it may be used in a granulated state. In order to cover cast-iron, sprinkle a thin coating of granulated, or other fine copper or alloy over the surface of the mould, to which may be added borax, or other flux, to facilitate the spreading or diffusion of the metal. Thus, when the molten iron is poured into the mould, the copper or alloy will be fused, so as to cover the casting, and render it secure against oxidation or corrosion.

If malleable iron is to be coated, put a covering of the pulverised copper or alloy over the upper surface of the iron, while it is being heated, and the borax, or other flux, will soon cause it to spread over the heated part, which should be plunged into water, to detach the scale of oxide that forms upon it. Ibid.

Specification of a Patent granted to Gerard Ralston, *merchant, Tokenhouse-yard, London, for improvements in Rolling Puddle Balls, or other masses of Iron, by employing a peculiar machine, for the purpose of compressing the iron into a state called bloom, preparatory to its being rolled into plates, or operated upon by tilt hammers.*—[Sealed 22d August, 1839.]

The machine consists of a rolling cylinder, revolving on an axle within a strong iron frame; a toothed wheel is attached to each end of the cylinder, which is acted upon by pinions, to give it the necessary rotary motion. A segmental piece of iron firmly fixed to the frame, embracing the cylinder, but in an eccentric position to the periphery of the cylinder; between this segmental piece of iron (which is semi-circular at the entrance) and the cylinder, the mass of iron passes in the form of a ball; a rotary motion being given to the cylinder, the mass of iron decreases in diameter, and increases in length, until it is delivered out at the bottom of the machine in the form of a roll.

The inventor claims, first, the entire machine.

Second, the mode of working the same in a horizontal position, if it should be found more convenient.

Third, by making masses of iron into balls, and then into rolls by one machine, either as the above or by substituting a piece of flat iron for the segmental piece, and having a second piece of iron wedge-shaped, working on an axle in conjunction with the flat piece, which might be made to produce the same effect.

Ibid.

Specification of a Patent granted to John Wilson, *Liverpool, lecturer on chemistry, for improvements in the manufacture of Carbonate of Soda.*—[Sealed 19th August, 1839.]

This improvement consists in using bicarbonate and sesquicarbonate of soda in preparing common carbonate of soda. The inventor obtains carbonate of soda from sulphuret of sodium, by adding one equivalent, or eighty-five parts of bicarbonate, to one equivalent, or forty-eight parts of sulphuret of sodium.

He also obtains carbonate of soda from the black ash usually produced by decomposing sulphate of soda, by adding bicarbonate of soda in relative proportions to the caustic and carbonate of soda contained in the black ash.

Claims the use of bicarbonate of soda, and sesquicarbonate of soda, in obtaining carbonate of soda from sulphuret of sodium, and also from the black ash obtained by decomposing sulphate of soda in the usual manner.

Ibid.

Progress of Practical & Theoretical Mechanics & Chemistry.

On Bone and its Uses in the Arts. By A. Aikin, *late Secretary of the Society of Arts, London.*

Most animal bodies are composed of soft and hard parts; of the latter, some are hard only when of a certain thickness, but when thin are tough and more or less flexible and elastic; such as the horns of all mammalia (except of the stag tribe;) the claws of the lion and tiger; the talons of the eagle; the horn of the rhinoceros; the coriaceous covering of tortoises and crocodiles; and the scales of fishes.

All these, by exposure to a gradually increasing heat, soften, enter into pasty fusion, give out the odour of burnt feathers, burn with jets of flame, and are consumed, leaving behind a very small proportion of earthy matter. 500 grains of horn leave not more than from 0.25 to 2 of phosphate of lime. Boiling-water, after long action, takes up from most of them scarcely any quantity of soluble matter, but they are perfectly soluble in caustic alkali, and the solution gives, with acids, a curdy precipitate. They are considered, therefore, as composed of condensed membrane, or, in chemical language, of albumen.

Other hard parts are rigid, considerably harder than the former; when dry, and in many cases when wet, they are very slightly flexible or elastic; and when struck by a hammer, or when bent beyond their power of resistance, break short with a splintery surface. When exposed to a red heat, with access of air, the membranous or animal part is destroyed; but the earthy part remains in sufficiently abundant quantity to retain the external form, and generally the internal structure, of the entire substance, of which calcined bone and calcined oyster-shell are examples. The original hardness of these parts is owing to the abundance of earthy matter that enters into their composition. When such parts are on the outside of the body, they are called, in common language, shells, horns, teeth, according to their position; and the uses for which they seem intended. When they occur within the body, they are called bones.

If, however, we restrict the term bone to its common meaning, we shall exclude the horns of the stag kind, and the substance which forms the body of most teeth, both which are truly bone, and shall include some substances, such as cuttle-fish bone, which is truly shell.

It is, therefore, necessary to enter into a more minute examination and comparison of these hard substances, in order to ascertain which of them are shell and which bone; and, as the result of our inquiry, we shall probably find, with respect to this class of natural bodies as with many others, that although the two extremes of the series are readily enough distinguishable from each other, yet they approach by such insensible intermediate gradations, as to render it impossible to say where the one begins and the other ends.

There is a class of shells comprising most of the univalves, which are harder than other shells, and when broken, present thick, parallel layers, the layers themselves having usually a finely fibrous structure

at right angles to the external surface. These fibres may often be seen to be nothing more than the transverse section of thin transparent parallel lamellæ, which, when viewed on their broad surfaces, often exhibit the usual natural joints of calcareous spar. When such a fracture is viewed by the naked eye, it has a good deal the appearance of porcelain,—whence their name of porcellanous shells. When carefully cleansed from all remains of the animal which inhabited them, they give out scarcely any perceptible odour on being made red hot, though their colour becomes somewhat grey. When unaltered they dissolve in dilute acid with much effervescence of carbonic acid gas, and a few hardly appreciable gelatinous flocks remain undissolved. These latter, on being collected and washed, give out, when heated, a faint odour of burnt animal matter, and become black before they are consumed. By proper chemical tests the soluble part of the shell is proved to have been carbonate of lime or chalk, the particles of which were cemented together with a very minute portion of animal mucus.

Another class of shells is the nacreous, so called from the varying and iridescent colours that they exhibit, resembling those of nacre, or mother-of-pearl; this very substance being, indeed, only a part of a nacreous shell.

These, when heated in a crucible, give out the odour of burnt feathers, often with a perceptible smoke, become of a dark-grey colour; and when submitted in this state to the action of acids, there remains undissolved a notable quantity of charcoal. In the recent state they effervesce with weak acids; and when the calcareous matter has been removed, there remains a series of flexible, membranous, or semigelatinous lamellæ, lying parallel to one another, and representing the form of the entire shell. These lamellæ have sometimes a distinctly fibrous structure, parallel to the surface of the shell; and though quite flexible while moist, they shrivel on drying, and become hard like horn,—a substance to which they bear the greatest possible analogy. The nacreous shells, therefore, are always very finely lamellar in structure, and are represented by some as composed of alternate layers of membrane and carbonate of lime; but the more probable opinion is, that the calcareous matter is intimately mixed with the membrane, rather than distinct from it. These shells increase in size, in order to accommodate themselves to the growth of the animal, by the deposition of new and larger layers from within; and hence the external surface is covered by concentric furrows or wrinkles, marking the outer margin of each successive layer.

Between the two classes of shells that I have described are others, the minute structure of which I am ignorant of, but which differ considerably in the proportion and condition of their membranous ingredient.

Thus it appears that all shells, how much soever they may differ from one another in structure, agree in containing carbonate of lime as their only earthy ingredient; and an animal substance, nearly resembling if not identical with, horn or membrane, as their consolidating or agglutinating ingredient.

Exactly the same substances, namely, carbonate of lime and mem-

brane, in various proportions, form the constituent materials of the madrepores and other hard corals.

On examining the hard covering of aquatic crustaceous animals, such as the crabs and lobsters, we find, after the action of acids, that there remains a whitish, soft, elastic cartilage, which represents the original shape of the part, and that the acid solution not only contains lime that had been in the state of carbonate in the original shell or covering, but likewise phosphate of lime, although in smaller proportion than the carbonate. The presence of this earthy salt forms an essential difference in chemical composition between proper shell and the covering of the crustacea, which latter substance may thus be considered as holding an intermediate position between shell and bone.

Some of the corallines, chiefly those belonging to the genera *Gorgonia* and *Antipathes*, approach still nearer in chemical composition to bone; and, indeed, are hardly to be distinguished from it, their earthy part being phosphate of lime with only a small admixture of carbonate, their figure and structure being represented by dense membrane, and, when boiled, they give out a notable quantity of true jelly, which, like other kinds of animal jelly, has the property of forming a precipitate with infusion of galls or of oak-bark.

The proportion of membrane in these substances varies considerably, so that while one species almost exactly agrees in composition with the horn of the stag, others contain so much membrane in proportion to earthy matter, as to be nearly identical with the bone of the cartilaginous fishes.

If a piece of true bone, in an unaltered state, be put into weak acid (muriatic acid, on the whole, is the best,) a moderate degree of effervescence will take place, showing the presence of some carbonate. By a continuance of this process for some days all effervescence and chemical action will cease; what remains undissolved will still represent the size and form of the original bone; but it will be semi-transparent, will exhibit a distinctly cellular structure, will be soft, flexible, and, to a certain degree, elastic. If, after being washed, it is boiled in water, it will be found to be in part soluble; and the solution, when boiled down to a proper consistence, will become viscid, and will gelatinize on cooling, and by drying will be brought to the state of hard glue. This jelly, when again dissolved in water, will become curdy and will give a grey precipitate with nutgall, and will exhibit all the other physical and chemical properties of gelatin; the remaining portion insoluble in water will become hard and somewhat brittle by drying, will burn in the fire like a piece of horn, will dissolve in caustic, fixed alkali forming a saponaceous liquid, and will show all the other properties of albumen or membrane.

The acid in which the bone was first steeped will give an abundant white precipitate of phosphate of lime by means of caustic ammonia, and will give a much smaller precipitate of carbonate of lime by carbonate of ammonia. Thus, by the action of a few simple re-agents, the essential constituents of bone are demonstrated. In this summary I have taken no notice of the oil or fat which is contained in the internal bones of all mammiferous animals, because it seems to be by no

means an essential part of bone; the horn of the stag and of other animals of the same kind being entirely free from it. On this account it is that hartshorn jelly, made by boiling the shavings of stags' horn in water, is often recommended to persons of very weak digestion in preference to other animal jellies, as being absolutely free from oil; for, though hard fat is incapable of dissolving in jelly, yet the softer oily fats will combine with it in small proportion.

But, although it is impossible to draw any marked line of chemical distinction between true bone and the indurated membranous textures that I have already mentioned, yet the mode of their origin furnishes a real and very important difference.

Of the organization of coralline bodies, indeed, we know nothing; for scarcely any of them have been even superficially examined when alive, and, when dried, all trace of structure in the soft parts is completely obliterated.

But with regard to the production of shell, both in univalve and bivalve testacea, we are certain that it never, as such, forms a constituent part of the living animal. A viscid fluid is secreted by certain organs; and it is only when discharged from the body that it assumes the consistence and other characters of shell: therefore, although we may with perfect propriety speak of the structure of shell, as we speak of the structure (that is of the mechanical arrangement of constituent particles) of a crystal, it would be a gross misapplication of terms to speak of the organization of shell; this latter meaning such an arrangement as is compatible with and necessary for the performance of vital functions. Shell is essentially a dead body, or rather one which never was alive; for though naturalists and collectors well know the difference between what they call a dead shell and another, they mean by this expression merely to point out the difference between an empty shell and one, the inhabitant of which was alive at the time of its capture.

The way in which the hard covering of the crustacea is annually formed (for these creatures change their shell every year) has not been sufficiently examined to ascertain whether it is at first a mere exudation which hardens out of the body of the animal, or is an induration of the cuticle by the deposition in its pores of calcareous matter conveyed thither by proper secreting vessels. If the former is the case, the shell of the crustacea is analogous to that of the testacea; if the latter, it some what resembles bone in the mode of its formation.

With regard to bone itself, there is no doubt that it is as truly organised and vital as any other part of the body. As soon as the rudiments of a young animal can be distinguished before its birth, the place of the future bone is indicated by a soft or semi-fluid matter inclosed in a delicate membrane; by degrees both the membrane and the matter which it incloses become more dense and cartilaginous; opaque white spots then appear, which soon after are penetrated by vessels carrying red blood; the deposition of bone then begins, and at the same time the cartilage seems to be gradually replaced by membrane. The rudimental bone, which at first was solid, now begins, at least in the long bones, to exhibit an internal cavity or hollow axis; thus showing that, while fresh matter is continually depositing to supply the growth of the

bone, that which had been already deposited is removed, and that this latter process takes place in the interior of the bone at a greater rate than the other does. The activity of the two vital processes of deposition and removal, or, to speak in technical language, of secretion and absorption, is, of course, proportioned to the rapidity of growth; so that, during the early periods of life, the bones participate with the soft parts of the body in the continual change and flux that is taking place within them. When the full stature of the animal is attained, these two actions probably diminish in rapidity, but still are kept up sufficiently to preserve the life of the part. As old age approaches, the removal of the earthy ingredient of bone seems to become more difficult; its proportion, therefore, to the membranous ingredient increases, and hence the bones of old animals are harder, of greater specific gravity, and more brittle than those of younger ones.

That very remarkable natural process, namely, the annual renewal of the bony horns of the stag and other animals of the deer tribe, is, perhaps, the most striking example and illustration of the circumstances necessary to the formation of bone. These horns arise from a short process or pedestal projecting from a bone forming the upper part of the skull, and called the frontal bone. At the season of the year when the horns are about to be renewed, an increase of vital action takes place in the bone, and a faint red line, indicating the presence of blood-vessels, will be perceived in making a longitudinal section of the bottom of the horn and the base on which it stands; the situation of this red line, indicating precisely the boundary between the dead horn and the live bone; absorption of part of the bone takes place, which loosens the adhesion of the horn to it, in consequence of which this latter falls by any accidental shock which it receives. The spongy tissue of blood-vessels, which may now be seen covering the end of the bony base, is soon entirely covered by the growth of the external skin; and this may be considered as terminating the first part of the process. Soon afterwards a small tubercle arises from the end of the bone, and presses upwards the skin which covers it; the tubercle rapidly elongates, the skin extends with it, and in the course of a few weeks it has assumed the size and shape of the future horn; in this state it is covered by the attenuated skin, which latter has pushed out an abundant growth of short fine hairs resembling the pile of velvet. Beneath this skin is a layer of blood-vessels, the diameter of some of which is equal to that of the little finger; these rest on a thin layer of dense membrane, of the same nature as that which covers ordinary bones, and called the periosteum; and within the periosteum itself is a flexible cartilage, penetrated in all directions by ramifications from the blood-vessels already mentioned.

In this state the future horn is very tender and exquisitely sensible, it bleeds when the skin is broken, and the animal often suffers much in this part from the bites of gadflies and other insects. When the cartilage has attained its full growth, ossification begins by the deposition of phosphate of lime, and goes on till the bone or horn has acquired its complete hardness. During this process, a ring of bony beads has been forming at the base of the horn, in the intervals be-

tween which the main trunks of the blood-vessels lie; these beads enlarge by the continual addition of bony matter, and in so doing compress the adjacent sides of the blood-vessels, and thus diminish the supply of blood; at length the sides of these vessels are quite squeezed together, circulation ceases, and all the soft parts die, shrivel, and dry up, and are rubbed off by the animal against the bough of a tree, leaving the dead bone, or horn, attached by its base to the frontal bone; till, after some months, the time for shedding it again comes round, when a repetition of the processes already described takes place.

Bones, even of the same animal, vary much in structure and in hardness, and no doubt in the relative proportion of their component parts, according to the situation in which they are placed, and the use to which they are put. Thus the shafts of the long bones, being wanted chiefly for support, are more or less in the form of a hollow cylinder, and the texture of the bone itself is dense and compact. Those parts of bones that form the joints or articulating surfaces by which one is hinged on to another require a considerable space for the joint, and for the attachment of ligaments; but as a degree of strength proportioned to its thickness is not wanted, the structure becomes cellular. A similar structure is observable in the flat bones, which consist of two thin parallel tables of dense bone, having a cellular part interposed between them. Hence, in utensils made of bone, the compact cylindrical ones are generally employed, both as being stronger and admitting of a more uniform and higher polish.

The bones of animals belonging to the same general class of nature are commonly observed to have certain points of general resemblance, by which they may be distinguished from one another, and are applied by man to various uses corresponding with such differences. Thus, the bones of fishes are softer, more flexible, and contain a much larger proportion of jelly and membrane, or, which comes to the same thing, a much smaller proportion of earthy matter, than those of the mammalia or warm-blooded quadrupeds; and the bones of these latter, comparatively dense and hard as they are, fall considerably short in density and hardness of the bones of birds, which, however, are generally too small and thin to be applied to much use in the arts.

Bone undergoes, much more slowly than the soft parts of animals do, the process of spontaneous decomposition; meaning, by this term, that disintegration of a compound which takes place either by the chemical re-action of its ingredients on one another, or by means of air, moisture, and common temperatures. The bones of a human body buried in a church-yard are, perhaps, mostly consumed in twenty or thirty years; yet under favourable circumstances they will endure for a much longer time with but little change. Thus, in the charnel-house at Morat in Switzerland, there still remain many bones of the soldiers of Charles the Bold's army, who perished there in 1438, being 401 years ago. When Sir Christopher Wren was rebuilding St. Paul's Church after the great fire of London, the workmen in digging for the foundations came to the floor of a Roman temple, dedicated to the goddess Diana, on which were the horns of stags and

bones of other animals. Tombs of the ancient inhabitants of this island are occasionally opened, in which are found bones that have been deposited there during many centuries; and I have the pleasure of exhibiting to you part of a carved bone spoon (discoloured and passing to a state of decomposition, it is true), which was found in an Etrurian tomb at Vulsinum, in Italy, possibly as ancient as the foundation of Rome. In the valley of the Lea are many peat mosses, the remains of ancient forests, now covered to the depth of several feet with alluvial silt. Many of these have of late years been dug into, on occasion of making docks and other excavations; and in or upon them have been found the osseous remains of boars, stags, and other animals, which have lain there from the time that these creatures roamed wild in the immediate neighbourhood of London. Not only the remains of individuals belonging to species now extant are still found, after being buried for centuries, but the bones of species now extinct, and many of which, judging from the habits of species nearly allied to them and now living, can scarcely exist except in warm climates, are found abundantly in the British islands, and in all parts of Europe. Remains of a large animal of the ox tribe are found in Essex. Elephants, hippopotamuses, and rhinoceroses, differing in many respects from any now known to exist, are also found in the same county, and in other places near London. Hyænas and tigers, also, of extinct species, occur in the cavern of Kirkdale, in Yorkshire, and in other caverns in the west of England; and in certain caverns in Germany are found the remains of two species of bear, differing, in some anatomical details, from any known living species of the same genus. There is no evidence that the human race was contemporary with these creatures; and yet, notwithstanding the enormous length of time that must have elapsed since the deposit of the animals in the places where their bones are now found, many of them are in a state apparently of almost perfect preservation. Membrane and jelly still remain in the bones; but the oil or fat, being uncombined with earthy matter, has disappeared.

In what I have hitherto said, I have alluded very slightly to the use of bone in the arts, which was the ostensible object of the present illustration; for I confess that I have not unwillingly been tempted to enter into the preceding physiological and other details, in order to relieve the dryness of mere technical description. In what remains I shall treat of the practical part of my subject, beginning with an inquiry into the use of bones as articles of food.

All animals that eat flesh will likewise eat bones, provided they are of a size to be easily crushed and masticated by them; so when a lion or tiger has taken one of the smaller antelopes, I presume he devours many of the bones along with the flesh, leaving only the spine, skull, and horns. But when he has pulled down a horse or buffalo, the case is different; the flesh alone of the animal is sufficient for an ample repast; the leg-bones and ribs are not to be cracked by a single straightforward crush of the jaw; and the spine, from its awkward shape, as well as by reason of the strong ligaments by which its parts are bound together, may well resist the lazy efforts

of an animal already satiated with food,—not to mention that the great length of the canine-teeth in the larger animals of the cat kind, as well as the small number of their grinders, render the act of gnawing both difficult and unnatural to them. The half-picked carcass, therefore, falls to the share of the wolves and hyænas. The former, after tearing off the ligaments of the joints, proceed to separate the bones from each other; and then, by gnawing, grind off the softer parts of the spongy articulating surfaces, in which they find a wholesome food. The hyæna, with far greater strength of jaw and of teeth than any other animal of his size, goes to work bodily, especially on the ribs and other flat bones, crushing them into large, splintery fragments, and swallowing them in this state, without fear of being choked or injured by their sharp points and rough edges. These two animals, therefore (including the dog, as a sub-species of wolf), are eminently the bone-eaters; the membranous and gelatinous matter of the bone, being dissolved out by their gastric juice from the earthy portion, undergoes the usual process of digestion; while the latter, apparently unaltered, passes through the intestinal canal, giving to their excrements the well-known appearance of half-dried mortar, and may afterwards be applied to all or any of the purposes for which bone-earth is used.

Man, the cooking animal, extracts nutriment from bones in a different way. When very hard pressed, indeed, he can stave off famine for a while, as Captain Franklin and his party did more than once in their exploratory arctic expedition, by taking bones, which even the wolves had left, and scorching them so as in some degree to subdue their hardness; and thus render it possible to gnaw and masticate them as a succedaneum for food, or, at least, as some alleviation of the agonies of famine.

But the animal matter of bones is best extracted by hot water. Every housekeeper knows that the nutritive quality of meat soups is much increased by boiling the bones together with the meat. In this way, however, only a small proportion of the food contained in the bones is made available; for part of the gelatin is with difficulty, and the membranous part is not at all, soluble in common boiling water; much even of the fat is locked up in cells of the bone, from which it cannot escape except these cells are broken into.

The solid part of the long bones contains very little soluble matter; it would therefore, in most cases, be a matter of economy to exclude them; the advantage to be derived from them by ordinary treatment not being equal to the value of the fuel which they would require. It is from the enlarged extremities of the long bones and their articulating surfaces that the principal supply of nutritive matter is to be derived; these parts, therefore, should be sawed off from the rest and broken into pieces. From the bones of young animals thus treated, boiling water will, in two or three hours, extract the whole or nearly the whole of the soluble matter; but, in the bones of older animals, the gelatin seems to be in a state of condensation approaching to that in which it exists in skin, and therefore requires the long-continued action of boiling water for its separation. By way of experiment, I

had the leg-bone of an ox sawed longitudinally and boiled for three or four hours. At the end of this time, the whole of the fat and mucus had been extracted, with part of the jelly. On applying the finger to the cellular part of the bone when wiped dry, I found the surface to be considerably sticky, and, on examining the cells, I found many of them completely filled with a transparent substance scarcely viscid, but much resembling pieces of glue that had been put to soak in cold water; by which, as every one knows, the glue swells exceedingly by absorption of the water, without, however, becoming viscid. A second boiling for three or four hours in fresh water dissolved out a considerable proportion of the gelatin; but still the surface of the bone remained sticky, many of the cells had a glazed surface, and, even after a third repetition of the boiling, only a few even of the superficial cells were quite empty. It is evident, therefore, that we cannot avail ourselves, with any regard to economy of fuel, of the whole of the nutritive matter contained in bones by the action of boiling water applied in the common way. But by means of a digester—that is, a boiler with a steam-tight cover and a safety-valve—we can without hazard raise the temperature of water from 212°, its boiling point in the open air, to 270° or 280°. At a less heat than even the former of these, not only the condensed gelatine but also the membranous part of bones is dissolved, if the bones have previously been reduced to small pieces, and the undissolved residue will be found to be a friable crumbling mass, with scarcely any remains of animal matter. It appears that bone soups are thus prepared at present at some of the hospitals and military head-quarters in France, and memoirs have been published, stating the advantage of making a collection of dry bones as part of the provisions of a garrison in case of siege, being a kind of food scarcely susceptible of decomposition or of destruction by rats or mice, and which would require no other magazine than simply making them into stacks and covering them with a roof of thatch or any other material. Complaints, it is true, are made of the burnt flavour which such soups are liable to have, and perhaps it may not be very easy to regulate the temperature of the water in the digester so as to avoid the empyreumatic flavour, and at the same time completely to extract from the bones the animal matter. On this account it is that another scheme has been proposed, namely, to put the bones, after soup has been made of them by boiling in the common way, into a stone trough, and then pour on them very dilute muriatic acid. By repeating this process in the cold a sufficient number of times, the whole of the earthy matter will be dissolved out, and probably without much, if any, injury to the animal matter, which will remain in the form of a porous membrane; by repeated percolations of water the acid would be washed out; or, if a little should remain, a last sprinkling with a solution of carbonate of soda would convert the acid into common salt. The membrane being now dried in the air will acquire a horny hardness, by which it will be rendered almost incapable of spontaneous decomposition, and would probably be found to be much more easily convertible into palatable human food by the common processes of cooking than the entire bone.

The plan, to say the least of it, is plausible, provided muriatic acid may be had, as it now may be, at a very small cost.

There is, however, a whole class of animals, the bones of which, without any chemical preparation, are presented to us by nature in a state capable, with very little trouble, of being converted into nourishment. I mean the whole class of fishes. The bones of these creatures contain so little earth, that, by drying and grinding them, a powder is obtained which, when made into cakes with meal, has proved a valuable resource to the people of Norway and Sweden in times of scarcity; and some of them, by simply browning on a gridiron, become quite friable, and, when treated with a proper quantity of pepper and salt, form a very palatable article of food.

Trans. Soc. Arts and Man.

Steam Navigation in France.—Extracts from the Report of Count Daru to the Chamber of Deputies, in the name of a special Commission intrusted with the examination of a projected law relative to the establishment of Steam Packets between France and America.

The form, dimensions, and power of steam-boats evidently depend on the service to which they are destined. They were not long merely employed in the ascent and descent of rivers, but soon the limits of steam navigation were enlarged, increasing the power of the engines from 20 to 80, 160, 200, and 250 horses, it became possible to extend the field of their employment to venture on the sea with them. Towing boats, which had been constructed in a few ports, soon threw a light on the superiority of the new system, by bringing out large vessels, weather bound and condemned to inactivity, and drawing them in their wake with a facility which seemed to defy the elements. From that day the bright days of sail-navigation, which, till then, was looked upon as the *chef d'œuvre* of human understanding, were eclipsed. Now vessels were started on every coast. Regular and rapid communications linked together every important town, such as Havre, London, Dover, Hamburg, Rotterdam. This was the forerunner of more daring attempts.

In 1819, a vessel from the United States, "the Savannah," had crossed the ocean from Liverpool to New York,* partly by wind and

* The first Atlantic steam voyage of the "Savannah" was from Savannah, Georgia, to Liverpool, and *not* "from Liverpool to New York." We find by her log book, which is now in possession of the American Philosophical Society, and which appears to have been kept with great precision, that she left New York under the command of Captain Moses Rogers, a native of Connecticut, on the 28th of March, 1819, and arrived at Savannah on the 6th of April; where the captain found it necessary to remain some days to take in fuel and put things in order, after which he sailed for Liverpool, where he arrived on the 20th of June.

About the middle of July he left Liverpool for the Baltic, reached Elsineur on the 9th of August, and left it on the 14th; put into Stockholm, and left it on the 5th of September; went to Cronstadt, and from thence to St. Petersburgh. Sailed again on the 10th of October, went to Copenhagen, and finally returned to Savannah, and from thence went to Washington.

partly by steam. America, then, had the lead again in daring to apply Fulton's machine to long voyages, and this is the more remarkable, that it has always had but few steam-boats on sea service. This first essay was not repeated until in 1835, when the English undertook the passage from Falmouth to the Cape of Good Hope; the Atlantic, provided with an engine nearly similar to that of the Savannah, accomplished in 37 day a distance of 2,400 nautical miles. The Berenice, the Medea, the Zenobia, performed passages of different lengths on the coast of Africa, and in the Indian seas. All these boats were English. In the Mediterranean, steamers of different nations, Neapolitan, Sardinian, Austrian, French, crossed from one port to another. Lastly, our service of steam packets from Marseilles to Alexandria was established, and threw open to us a new access to the East. The passage to Constantinople, which was sometimes forty-five days in duration, was thus reduced to thirteen and a half days.

These numerous experiments gave rise to the idea that, by the aid of steam, it was possible to accomplish the distance between Europe and the United States. The difficulty of carrying the necessary quantity of coals for the consumption of an engine acting, without interruption, from one shore of the ocean to the other, during a space of from fifteen to twenty days, was no longer an obstacle. It had been discovered that the consumption of combustible did not increase in the same ratio with the power of the motors,—that an engine of 250 horse power, for instance, was far from burning twice as much fuel as was necessary for an engine of 125 horse power; that, moreover, certain parts of the mechanism might be simplified in such a manner as to take up less room, and consequently, leave more space at disposal for the accommodation of passengers or merchandise. From this time operations were commenced, and on the 4th of April, 1838, the first experiment was tried. You are all acquainted, gentlemen, with the result. You all beheld the enthusiasm excited by the success of the voyage undertaken by the Sirius, fifteen days had been sufficient for its passage. Scarcely had this vessel arrived in the port of New York, when it was joined by the Great Western, which started from Bristol on the 8th of the same month, after a passage of fourteen days.*

Henceforth the problem was solved. America was nearer the European continent by half the distance which formerly separated them. There could be no more doubt concerning it; the events which have since occurred have ratified these first expectations.

The Great Western has crossed the Atlantic twenty-eight times during the period of the fourteen months just elapsed without accident, maintaining an almost uniform speed, of which the average time was

* The length of this boat is 236 feet, its depth 23 feet 3 inches, its width outside the paddle boxes 58 feet 4 inches, draught corresponding to the load, 16 feet, tonnage 1,340 tons. The engines are so constructed as to diminish the consumption of steam and fuel. It is said that they consume 33 tons of coal a day. The total cost of the vessel when it was launched was 55,000*l.*; since that time improvements have been effected in it which have amounted to 15,000*l.* It carries 700 tons of goods, 135 passengers. The rest represents the weight of the engine, the boilers, and the water.

sixteen days going, and from thirteen to fourteen days coming back: the last voyage was even accomplished in eleven and a half days.

During two years, since they begun their operations, with what strides have the English advanced?

A first line from Bristol to New York was established in 1838. The company to whom it belongs has four steamers of 450 horse power —namely, the Sirius, the Great Western, the Royal William, and the Liverpool. The price of each of these boats is 1,300,000f. It is said that they now are building an iron steamer, which is to carry two engines, whose united powers will amount to 1,000 horses. These engines were constructed on the plan of Mr. Humphreys; the boat will only be 100 metres in length, and will have room for 300 passengers, and a considerable quantity of merchandise. The works are in active continuation, and will be terminated, according to appearces, in the course of the year 1841.

Another line was established for the service of London and New York. Two vessels were employed on it—the British Queen and the President; the engine of the British Queen was of 500 horse power, that of the President 600; they can accommodate from 225 to 250 passengers, and receive a load of from 500 to 600 tons. A third line connects New York to Liverpool, so that there are already three establishments sending steam vessels from different parts of Great Britain to the United States.

Moreover, a compact was sealed on the 4th of July, 1839, between the Admiralty and Mr. Samuel Cunard, for the transit of letters from Liverpool to Halifax. Mr Cunard has engaged that there should be two departures per month, and receives from the Government an annual remuneration of 1,500,000f. The Britannia, of 450 horse power, was launched into the sea in the beginning of February, 1839.

Lastly, a more extensive service will soon connect Great Britain with the West India Islands; there is a company in existence under the name of the Royal Steam Navigation Company, which is preparing vessels for New Orleans, Mexico, and part of the South American coast. This company the Government indemnifies by an annual payment of 6,000,000.

You must all perceive, gentlemen, that we must not delay entering into the lists, for we are urged on by competition from every quarter, and the appearance of English steamers on every point of the New World to the exclusion of our own, would soon banish us from those regions.

However serious the character of these motives, gentlemen, they are, however, secondary when compared to the consideration which we will not endeavour to conceal. The navy is a weapon, and one which to all appearances is destined to play an important part in the conflicts which a future day may bring to light. Attempting to foretell what consequences may be reserved for a future period by the introduction of steam in constructing ships of war would be presumptuous; it is a question of entirely recent origin; experiments with regard to it are in their infancy. It is, however, already discernible that the use of new motors will infallibly produce the following effects:

—In the first place, it will render every vessel in similar conditions equally supple and tractable, by whatever men she may be manned. It will be sufficient to have able engineers in order to effect manœuvres with a facility and precision as entirely independent of the state of the sea as of the greater or less aptitude of the sailors.

Secondly, the number and proportion of the men required for the performance of the ship's duty would be entirely changed. The Great Western, whose form and dimensions are nearly those of an ordinary frigate, is conducted by fifty men, including engineers and stokers. Now, if it be true that the naval enrolment of France is incompetent to supply all its necessities, this inconvenience will vanish; and the more so, because the zone in which we shall be able to find men fit for the service will be extended.

Lastly, the draught of water occasioned by a steamer depends upon its power; but for all it is less than that of ships of war. Whence it follows, that instead of the five or six ports to which our vessels and frigates can resort, steam-boats will be able to cast anchor off any coast, and, so to speak, in any bay.

Thus the new vessels provided with a good engine will be swift, will offer less hold to the enemy, will have a greater number of safe harbours to resort to, will require a less numerous crew, and require less previous apprenticeship than in sailing vessels. This will evidently become a new weapon; and if these ships carry guns for the discharge of bombs of a recent invention, whose effect is such that at one discharge they are capable of disabling the largest craft, they will become a weapon at once easy of management, safe, and of the most destructive nature. Is there not wherewithal here to change the whole direction of naval tactics, all the proportions existing between the powers of nations? Here is an entire revolution. Slow or fast, partial or complete, this revolution will ensue. Now, with the example given us by a Government whose energetical endeavours are dedicated to the continued increase of its naval resources, when we see Great Britain during two years continually multiplying, at the cost of such enormous sacrifices, its steam navigation, and finding in the gigantic establishments of its industry those inexhaustible resources of which we are deprived, would it be wise, would it be prudent, to continue our *materiel* in its present state, to abstain from making some progress in the new career which has been traced out to us? Undoubtedly we do not indulge in the chimera that our country can ever equal the English in their naval establishment. The strength of the British nation rests entirely on its foreign trade; they are an exclusively seafaring nation. All the springs of its prosperity are there; it drags after it that colossal superiority which constituted at once its greatness and its peril. The conditions of existence in which France is situated are different; but the extent of its coast, its position, the genius of a portion of its inhabitants, compel it to possess a navy, and in that case it is becoming that, wherever she may be pleased to hoist her flag, she may be enabled to assemble and display a sufficient force in order to

insure respect. Without this she could never effectually protect her national interests beyond the seas.*

The construction of steam-boats for transatlantic voyages presents, then, a double object to our view. Applied, in time of peace, to the growth and preservation of our commerce, they may be transformed, during hostilities, into ships of war; they may assume, in turn, the double character of a defensive weapon and of a means of conveyance —of a commercial and of a military navy; to-day they may carry merchandise, and when requisite guns. Civ. Eng. & Arch. Jour.

Steam Packets to convey the Mails between France and America.

We, Louis Philippe, King of the French, have proposed, the Chambers have adopted, we have ordered and do order the following:—

Article 1. A line of steam packets shall be established in order to convey the mails between the ports of Havre and New York.

The Minister of Finance is authorized to treat, within the space of three months, with a commercial company who will undertake the service, on condition that they receive in payment an annual fee not exceeding 880f. per horse power. The number of steam packets to be employed in the service of this line shall be three at the least, or five at the most; each packet to be propelled by engines of 450 horse power.

A list of conditions, to be drawn out by the administration, will determine the times of departure, the number of passengers, and every detail relative to the service of this line.

2. Two principal lines of communication shall be established by the Government, in order to convey the mails between France and America, and served by steam packets of 450 horse power, one starting from Bordeaux every 20 days, and from Marseilles every month, in order to arrive at Martinique, and continuing by Guadaloupe, St. Thomas', Porto Rico, Cape Hayti, and St. Jago, to Havanna; the other starting from St. Nazaire every month to Rio Janeiro, passing by Lisbon, Goree, Pernambuco, and Bahia. Three secondary lines, served by steamers of 220 horse power, will be established in order to continue the principal lines, the first to Mexico, touching at Vera Cruz, Tampico, Galveston, and New Orleans; the second to Central America, touching at Chagres, Carthagena, Santa Martha, and La Guayra; the third to Montevideo and Buenos Ayres.

To effect this a special credit has been opened to the Minister of the Navy, to the amount of 28,400,000f., to be devoted to the construction, arming, and fitting up of 14 steam packets of 450 horse power, and four steam packets of 220 horse power, and which is to be appropriated to the expenditures of 1840, 1841, 1842, and 1843.

* England had, in 1831, 840 commercial steam-boats, representing altogether 64,700 horse power. Besides which, the English Admiralty possesses 66 vessels, whose powers amount to nearly 9,400 horses, while in France we reckon only 640 commercial steamers, and 38 belonging to Government.

From the total sum of 28,400,000f. a grant is made to the Minister of the Navy—

	Francs.
1. For the year 1840, of - -	5,000,000
2. For the year 1841, of - -	10,000,000
Total - - - -	15,000,000

3. The steam boats belonging to the Government shall be constructed so as to enable them, in case of necessity, to carry guns, and when performing the duty of packets to carry merchandize. Ibid.

Incrustation in Steam Engine Boilers.

We are informed by *L'Echo du Monde Savant*, of the 25th of July, that M. Edouard Richard had presented to the Geological Society of France a calcareous incrustation, which must be considered of great value, as it was not formed in the boiler, but in the cylinder of the engine, and beneath the piston. The incrustation formed a disc 12½ centimetres in thickness; and in consequence of the pressure of the piston, it is so hard that it is capable of receiving as high a polish as the densest marble. It is evident, therefore, that explosions may be produced as well by calcareous concretions of the cylinders as of the boilers of steam engines. The engine from which this specimen was procured, has been used for the purpose of pumping water from the mine of Auzin, and has been built after Newcomen's plan.—In *L'Echo du Monde Savant* of August the 5th, we find a communication upon the subject of steam boiler explosions by M. Flesselle, a retired officer of the French Marine, resident at Graville, near Havre. M. Flesselle suggests, that, in order to prevent the formation of calcareous incrustations, (which have long been considered the principal causes of accident,) some common salt or muriate of potash, should be put into the boiler with each fresh supply of water. M. Flesselle recommends this measure, because the incrustations are formed of the carbonate, the sulphate, and perhaps the phosphate of lime—(salts, insoluble, or sparingly soluble;) and these salts, boiled with the muriate of soda (common salt,) or muriate of potash, will undergo double decomposition with these muriates; the products being the carbonate, sulphate, and phosphate of soda, and the muriate of lime—salts all of which are soluble.

M. Flesselle says that M. Chaix, of Maurice, has invented a method of preventing explosions, which appears to have been adopted with success in the French government steam vessels; but M. F. considers that auxiliary means also are requisite—and we think he is right; for the fact we have related regarding the engine at Auzin, proves that we should avail ourselves of every cheap and simple aid to prevent the fearful accidents to which incrustations may give rise, seeing that the sulphate, carbonate, and phosphate of lime may be held in suspension by the steam—be carried by it in a state of minute molecular division even into the cylinders—and there also be deposited in the form of hard concretions.—The method of M. Flesselle, seeming found-

ed on correct chemical principles, will, we hope, be put to the test of experience, by some of the numerous engineers of our neighbourhood. We shall feel great pleasure in recording the result.

In England the precaution taken against incrustations is an index of the density of the fluid in the boiler; but this is evidently inadequate —for the calcareous particles are conveyed by the steam into the pipes and cylinder. Perhaps some of our scientific readers will have the goodness to inform us whether the English method of preventing incrustations is identical with that of M. Chaix.—*Gateshead Observer.*

Ibid.

On the Construction of Lime Kilns. By Sir C. G. Stuart Menteath, *Bart.*

Having been engaged in burning lime for the supply of an extensive district of country for agricultural improvements, and being distant from coal sixteen miles, it was desirable to find out the best constructed kiln for burning lime with the smallest quantity of coal, and having been aware from experiment that the kilns generally employed in Great Britain for burning lime are of a construction too narrow at bottom, and too wide at top, many kilns of this construction being not more than three or four feet wide at bottom, and 18 feet wide at the height of 21 feet, were found to waste the fuel during the process of calcining the lime, or in other words, did not produce more than two measures of burnt lime shells for one measure of coal; but it is to be understood, that in whatever construction of kiln lime is burnt, the fuel required to burn limestone must vary according to the softness, or hardness, or density of the stone, and the quality or strength of the coal used. The same measure of coal in Scotland called chews, when employed, will burn a greater quantity of lime in a given time than the same quantity or weight of small coal, the chews or small pieces of coal admitting the air to circulate more freely through the kiln. Though this fact should be well known to lime-burners, yet they frequently employ small coal in burning lime, from its being procured at a less price, though really at a greater expense, as it requires a much larger quantity to produce the same effect, and a longer time to admit of equal quantities of lime being drawn out of the same kiln in a given time.

For a sale of lime for agricultural purposes in a limited district, I have found kilns of small dimensions to be most profitable; the construction of a kiln I have employed for many years was of an oval shape, five feet wide at bottom, widening gradually to six feet at the height of 18 feet, and continuing at that width to 28 feet high from the bottom. A kiln of this construction has been found to burn lime in much less time, and with a smaller proportion of fuel, than kilns of large dimensions, narrow at bottom and wide at top, as heat is well known to ascend more rapidly in a perpendicular than in a sloping direction, from which arises the superiority of a narrow kiln, with sides nearly perpendicular, compared with one with sides that slope rapidly.

Those narrow kilns will admit of being drawn out of them every

day, if fully employed, more than two-thirds or nearly three-fourths of what they contain, of well burnt lime, and afford fully three of lime-shells for one measure of coal, when large circular kilns will not give out more than one half of their contents every day, and require nearly one of coal for every two measures of lime burnt. In a country sale of lime, the quantity sold every day is liable to great fluctuations; two or three cart loads will sometimes only be required from an establishment which, the day before, supplied forty; and as lime is known to be a commodity, when exposed to the action of air, which becomes more bulky and heavy, and in that state does not admit of being carried to a distance without additional labour, it has been an object of importance with me to find out a construction of a kiln which will allow of lime being kept for several days without slacking, and at the same time to prevent the fire escaping at the top of the kiln, if the kiln stand twenty-four hours without being employed, especially during the autumn and winter when the air is cold and the nights long. I now employ kilns of an egg shape, and also oval; the oval-shaped kilns are divided by arches across the kiln, descending four feet from the top; the object of the arches across the kiln is to prevent the sides of the kiln falling in or contracting, and also to enable you to form circular openings for feeding in the stone and coal at the mouth of the kiln; upon this plan, a kiln of any length might be constructed with numerous round mouths. From the great expense attending the driving of fuel from a distance of twenty-five miles from my own coal-pits, I have adopted the practice of cokeing the coal, which is a saving of two-fifths of the weight, and I find that an equal measure of coal and coke have the same quantity of heat in burning lime, which is somewhat paradoxical, but not the less true. The coal is found to have little effect upon the stone till it is deprived of its bitumen, or is coked in the kiln; for, during the time the smoke is emitted from the top of a lime kiln, little or no heat is evolved; or, in other words, does not the smoke carry off the heat, which is not given out from the smoke till it is inflamed, which does not take place in the ordinary lime kilns? A kiln in which coke is the fuel employed will yield nearly a third more lime shells in a given time than when coal is the fuel, so that coke may be used occasionally when a greater quantity of lime is required in a certain time than usual, as it is well known to lime burners that the process of burning is done most economically when the kiln is in full action, so as almost constantly to have a column of fire from the bottom to the top of the kiln, with as short intervals as possible in working the kiln.

Having found that limestone is apt to be vitrified during the process of calcination during stormy weather, from the increased circulation of air through the kiln, which adds much to the heat derived from the fuel employed, and which experienced lime-burners would have diminished could they be aware at all times of an occurrence of this kind; from having experience of the bad effects of too great a circulation without properly providing against it, I have reason to believe that by having a power to throw in at pleasure an additional quantity of air into the bottom of a lime kiln, a considerable saving of

fuel necessary for the calcination of lime would take place, and another object would be gained, that of cooling the limestone in the bottom of the kiln, which frequently retards the drawing out of the burnt limestone for some hours, or until the limestone is so cold as not to burn the wooden structure of carts.

In working a kiln with narrow circular mouths, the stone and coal should be carefully measured, so that the workmen can proportion the fuel employed to the quantity of stones, and it is obvious, that the quantity of coal to be used must depend upon its relative quality, and the hardness of the stone to be burnt. If this measure was adopted in kilns of any construction, the lime shells would be found better burnt.—[*The Dublin Advertiser.* Civ. Eng. and Arch. Jour.

Galvanic Battery.

Much difficulty arises in naming the two poles of a battery; they are called the positive end and the negative end, the anode and the kathode, the platinode and the zincode; now as each pole of a simple battery becomes reversed if the battery is doubled, Mr. Smee proposes (*Philosophical Magazine*, for May) to name the two ends from the oxygen and hydrogen, since it has been shown that the galvanic current owes its power of decomposing many substances entirely to these gases. The names which are proposed are the *oxode*, at which oxygen is evolved, and the *hydrogode*, where the hydrogen is given off.

Mech. Mag.

On the Augmentation of the Force of Powder by the Admixture of other Bodies. By Mr. Mayer, Mining Superintendent at Gengenbach, near Offenburg, in the Dutchy of Baden.

As it may be interesting to such of your readers as are engaged in mining pursuits, to be made acquainted with the various results in different districts, of the method now known for several years of mixing powder with sawdust, in order to obtain increased effect in blasting, I hope it will not be unacceptable to them and to the mining public in general, if I present them the following details of the experiments made in this district; since, by comparing these with other trials, improvements may probably be suggested in the method of procedure:—Our first efforts were directed to ascertain the exact proportion of the sawdust to the powder, in order to obtain the maximum of expansive force; and it was found, after numerous trials, that in some of the mines of this district, where one pound of powder was formerly used to make up six cartridges, now nine cartridges are made up with the mixture. In other mines of the Grand Dutchy of Baden, and particularly in my own official district, one pound of powder used to be requisite to fill eight cartridges, but on being mixed with sawdust, one pound of powder was sufficient for twelve cartridges; and, afterwards, on our becoming more skilled in the management of the whole

process, sixteen cartridges were made from the same quantity—an increase of one-third, and subsequently of one-half in the number of cartridges—the effect being found equal to what could be expected from powder alone, and failures in the blast not being more frequent than is usually the case in all mines; of this I have been an eyewitness, in a very great number of instances.

It has been objected that the additional length of the cartridges would render it necessary to work a deeper hole in the rock, so that the increased labour required would in part counterbalance the saving of powder; but to this remark I have to reply, that the superior elasticity of the mixture admits of the six-inch cartridge being pressed down by the clay to the length of four inches only, and consequently, in a hole ten or eleven inches deep, there remains six or seven inches for the clay, which is, beyond doubt, quite sufficient; and it may be observed, that the holes are very seldom worked to a less depth than ten to eleven inches. In some places, however, the mixture has not met with the same approbation; but I am not able to state whether this be owing to a want of correctness and attention in the operations, or to a lurking prejudice against innovation.

The objections which had been brought forward against the sawdust, led me to reflect whether some other substance might not be equally efficient, and an incidental circumstance seemed to indicate the very material. Being out with a shooting party, after firing my piece several times, I found myself at a loss for wadding, and, in the hurry of the moment, made use of some envelopes of letters, on which there was a more than ordinary quantity of sealing-wax. I had scarcely pulled the trigger, when I experienced a gratification not generally calculated upon by sportsmen—that of being, in no very gentle manner, extended on the turf—and the pain I felt in the shoulder and head, might have made me wish I had postponed the shot till my next excursion, if I had not thought I had made the very discovery of which I was in search, since I naturally attributed the force of the charge to the sealing-wax. On my return home I made some trials, not with the usual component parts of sealing-wax, but with the colophorium (resin) alone. For a bore requiring two ounces of pure powder, I took one and a half ounce, adding the eighth-part of an ounce of powdered resin, which was combined with the powder by friction on a sheet of smooth paper, the mixture being indicated as accomplished, when the black colour of the powder assumed a yellowish hue from the resin. Being filled into a cartridge for a hole sixteen inches deep and one inch in diameter, bored in a granite block of great hardness, and two and a half feet long, two feet wide, and two and a half feet high, the cartridge occupied three inches, and the remainder was rammed with heavy spar. The explosion was perfect, and the mass burst into four nearly equal pieces, besides several small ones—one of the former being thrown a distance of four paces. Concluding from this excess of force, and from the well grounded report, that less powder would do, I tried, in a similar hole, one ounce of powder to one-sixteenth of an ounce of resin, and I was pleased to find the effect fully equal to what might be expected from two ounces of powder alone.

After these experiments, I found it easy to account for the violent recoil and loud report of my fowling-piece—the resin having produced a more immediate and rapid ignition of the whole mass. It is to be observed, that on using unmixed powder, many of the grains are lost, as is evident from the black streaks discernible after shooting over snow with the gun muzzle near the ground—the piece being held horizontally. These marks or streaks of powder must generally consist of one-half of the charge, but similar appearances are not visible on using the mixture. I was now so fully convinced that this last mixture would effect a saving of one-half of the powder, that I immediately introduced the use of it in these mines, where it has ever since, namely, a year, been used with the same uniform result, and has even been adopted in a colliery, where the managers had previously tried the sawdust without success.

On using this mixture of colophorium, there never occur those so called (Bichsen,) but the whole rock round the hole is sprung from the powder-bag; and, moreover, it is observed, that the blast takes effect in almost every case below or behind the bore in the rock itself.

With regard to the expense of the commonest resin, which is what I use, the value of one ounce of it to one pound of powder is very little; and even the finest resin, at two kreutzers the ounce (about three farthings,) saves a pound of powder, which usually costs from twenty-four to thirty kreutzers (from 8d. to 10d.)

I next made trials with the *semen lycopodii*, which possesses in a high degree the qualities requisite for the immediate combustion of the powder, and found it to produce the same effects as the mixture with sawdust or with resin; but as a pound of this seed will suffice to mix with powder for 512 blasts, I consider that its application may be advisable when it can be procured in sufficient quantities.

Mining Review.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

The Paris Fair of 1839.

The exposition of the objects of French National Industry at Paris, in 1839, was a brilliant affair. A building was erected under the direction of M. Moreau, the government architect, in the great square of the Champs-Elysées, six hundred feet long, and two hundred and seventy wide, fronting on the grand Avenue. The façade exhibited five openings, the central one being decorated by a saillant peristyle, and the continuous acroter which crowned the façade was divided into compartments, on which were inscriptions in bas-relief which announced to visitors the divisions and classifications of the objects of the interior.

The bas-reliefs, ingeniously devised by the architect, exhibited the different branches of industry, being represented by children or little genii, performing the manual and theoretical operations which

brought forth those rich productions (plates representing these designs are given in the *Recueil de la Societié Polytechnique*, for May, 1839.) We have thought it would not be uninteresting to our readers to be in possession of the substance of the address to the king, and his reply on the occasion of this splendid exposition. G.

Discourse addressed to the King, by Baron Thenard, President of the Central Jury.

Sire,—It was a happy thought which conceived the plan of exhibiting specimens of all the most remarkable fruits of the industry of a great population, and of perpetuating the remembrance of it by rewards imposingly distributed by the head of the nation.

This idea is the more worthy of France, inasmuch as it was first accomplished when she was combatting with all the powers of Europe, leagued against her independence.

More than forty years have since elapsed; the plan has of course been subjected to the ordeal of time, and the still more trying ordeal of political revolutions.

The consulate received it from the directory to attach it to the empire, which, in turn, transmitted it to the restoration. The government of July adopted it as a National Institution.

Its early operations could not fail to be injured by the calamities which war always brings in its train; but peace was no sooner re-established and consolidated, than industry, which had been, as it were, enchained, sprang forth afresh, kindled under the light of experience, and penetrated into regions where it was before unknown. The fairs of 1819 to 1827, revealed to England the truth that she would soon have a rival in the arts. These high hopes were justified by the exhibition of 1834, and are realized by that of 1839.

Yes, sire, a grand progress has been made within the last few years.

Wool spinning by machinery we have completely acquired; that of flax will not be long in arrears. These are arts which will form important additions to the balance sheet of our commerce.

More than fifty factories have constructed steam engines of common force; let the state assist them and soon will they furnish those powerful motors which our marine and our industry are now demanding. Steam factories were scarcely in existence in France at the beginning of the present century; now they are counted by thousands; our manufacturing villages will in time be covered with them.

Paper machines for continuous sheets have been carried to so high a degree of perfection that they are exported to foreign countries.

The Jacquard loom, so eminently useful, has received new improvements.

An ingenious mechanism fashions wood into furniture, ornaments, gun stocks, &c., with great rapidity and precision.

Excellent tried chronometers cost one half less than in 1834; all our ships will be provided with them, and will be no longer in danger of a fatal coast in stormy weather.

From England came all the needles requisite for our use,—France now produces them in the most desirable perfection.

New products have sprung up in our factories; the starine candle, so unexpectedly pleasant; the dye of prussian blue, which in time will supersede entirely the use of indigo.

Our flint glass is as limpid and of as perfect a cut as foreign glass—it is sought for from abroad on account of the elegance of its forms, the variety of its colours, and the solidity of its metallic decorations.

Nothing more beautiful and splendid than our window glass;—it surpasses that of the ancients, so justly extolled.

The manufacture of flint and crown glass by a systematic process, which would furnish them of perfect quality and convenient dimensions for all optical purposes, has been long an object of anxious search; this important problem is now solved.

A great advance has been made in the mode of decorating porcelain and increasing its value.

Lithograpic stones, of superior quality, have been discovered in several parts of the kingdom; and the rarest works can now be reproduced by lithography, with all the characters which distinguish them.

The beautiful marble of our Pyrenees, scarcely known fifteen years ago, now not only suffices for our own wants, but has become an article of considerable export.

Iron is preserved from rust by means very simple and apparently efficacious.

Laminated bronze lines our vessels, and insures them a duration greater than those of copper.

Nitre, by an improved process, is manufactured in competition with that of India.

Our calicoes, silks, and shawls are constantly displayed in the shops of London, and our muslins, plain and embroidered, seem driven from our markets to those of England and Switzerland.

In the management of silkworms great progress has been made; a great number of mulberries have been planted; and there is every reason to believe that in ten years France will be relieved from the tribute which she is paying to foreign countries, the amount of which is not less than 40,000,000 francs annually.

Starch is transformed, at the will of the manufacturer, either into a low priced sugar, which serves for the improvement of wine and beer, or into dextrine, which takes the place of gum senegal in calico printing, colouring, and dressing cloth. The fabrication of these articles amounts to 6,000,000 kilogrammes (=14 mill. lbs.)

Eight years have scarcely elapsed since England furnished us with all the varnished leather which our consumption required. At present England is obtaining it from France. In the art of tanning great progress has been made. Our moroccos obtain the preference in every market.

All the branches of industry have improved; in almost all the prices have fallen.

(The President proceeds to descant upon the vast accessions of the arts and to human skill and power which have been witnessed within the last forty years,—claims for France and Papin the *invention* of the steam engine, but ascribes to Watt its *perfection* and applications.

He brings into view as the causes which have produced these wonderful results:—)

Peace, which is the soul of industry; Science, which sheds a most vivid light upon the arts, and preserves them from the errors of a blind and deceptive routine of action; learned societies, and especially *la sociétié d'encouragement* which, by its numerous and energetic assemblings, have resolved the most important and difficult questions.

(Another cause to which much of these effects is assigned is the public exhibitions, bringing together vast numbers of all classes to witness the progress of art, and the beauty of its productions, tending to aggrandize the French name, and to make the people proud of their country. In a few years they will have nothing to envy from England.)

Yourself, Sire, and by your example the Prince Royal, have been happily convinced, while surrounded by your august family, you have spent whole days in visiting the exhibition with so lively an interest. Every fresh visit has been a source of increased pleasure. It has induced you to address congratulations to the manufacturers with whom you have been pleased to converse, and your praises have been the more touching from the paternal kindness which have accompanied those evidences of discernment which an intimate knowledge of the arts could alone confer.

In fact, when we consider what was the state of things at the termination of the empire, and what it is now, who can tell where the progression will stop if its rapid march is not suspended by WAR? Its destinies will be immense. Enlightened by science, it will imprint its character and genius on the age, and there will hereafter be ages of industry as there has been ages of warriors, and ages of literature and painting.

Sire, you have been able to preserve peace in the midst of a revolution which might have produced a general conflagration. Your exalted wisdom will be able to sustain it; this will be your work and your glory. A new era, a pacific era, will take its date from the foundation of your dynasty. Instead of destroying, you will build up. Already have you saved from certain ruin the palace of a great king, by founding upon it this monument, this historic museum, which alone is sufficient to render one reign illustrious. You will cause letters, science, and all the arts to flourish; you will vivify agriculture; you will cause commerce to reach the most distant countries; you will every where spread the blessing of civilization.

History will not inscribe your name among conquerors, but posterity, just in its decision, will place you, sire, in the list of kings who have been the fathers of their people,—of crown princes, rare indeed, who devote their lives to the salvation of their country, and who use their power only to give a more useful direction to the true sources of public prosperity.

The King's Reply.

To perform this task is the first of my duties;—to learn from you that I am advancing towards its accomplishment is the sweetest re-

ward that I can receive from my labours, and my efforts to secure the happiness, the greatness, and the prosperity of France. Gentlemen, I was impatient to be in the midst of you, to thank you in the name of my family and for myself, for all the sensations you have inspired me with, whenever I have visited this magnificent exposition which you have just given to France;—to tell you how intimately I feel myself associated with your labours, and how pleased I am in believing that their constantly increasing results will justify the high hopes which your worthy President has just presented to my view. I agree with him that it is to the epoch of that terrible crisis in which so many sacrifices were made by the nation,—in which every French heart sprang from its fireside to the defence of its country,—abandoning its profession, its family, its dearest interests, to preserve France from foreign invasion,—that was commenced the long series of expositions of its genius which years have just crowned in so brilliant and splendid a manner. In the very deficiency of those early efforts, might be seen an expression of the wish of France to urge its government and those who then presided over its destinies, to put an end to the scourge of war as soon as the honour of the country should be satisfied, and its independence secured. In fact, the vow of France and its first necessity was to enter into a state of peace, the only means of regaining all the safety and repose necessary to the free indulgence of its genius and the full development of its best faculties. In was, in some sort, a salutary warning that the time had arrived when the resources of France should be applied to its real wants, and no longer absorbed in the pursuits of chimerical conquests, in the subjugation of its neighbouring people, and in the extension of a domination in which we have no interest nor any desire of persevering. But these times of trial are already remote; the national wish has prevailed. Internally tranquil, we are at peace with all our neighbours, and nothing need disturb you or constrain you in pursuing after those combinations in which you are so happily engaged. It is by a judicious employment of all our resources, that private fortunes must continue to increase and ease and comfort spread from family to family. You have already succeeded in furnishing the poorest and most necessitous classes with the low priced stuffs which clothe them, in satisfying their wants, and in procuring for them comforts until now unknown, by the reduction of prices to the means within their reach. For these blessings you deserve their thanks. It is thus that you really become their protectors and true friends of humanity;—you contribute by your labours and success to the improvement of the condition of all classes of society and are in the way of accomplishing the wishes that are dearest to my heart.

Continue in this noble career with perseverance. The exposition exhibits productions which demonstrate that you are in the good way, that is to say, that you prefer the solid and the useful to the brilliant and the tinsel, which merely seduces. By thus infusing good faith into the composition of your products you inspire that confidence which can alone give prosperity to commerce and turn the people from that deplorable mania for hoarding up, which, by absorbing a portion of

the resources of society, paralyses the means of augmenting the national wealth and of course the public prosperity. They must have confidence in your good faith and in the moderation of your prices. The nature of your products must be such that their uses may calm distrust, and convince the purchasers that they have not been deceived. The people must learn that there is no occasion for them to hoard up and to bury their riches in the earth, in order to place them in security. The actual state of civilization ought to convince them that such fears can only exist among a demi-barbarous population who know no law but force, and whose chiefs think only of appropriating to themselves the wealth and the property of their subjects.

For ourselves, we have, thank God, another mission to fulfil. It is ours to protect the rights of all, to cause the property of all to be respected, to prevent any one from touching it without the consent of the owner. The imposts regularly voted by the nation are employed in its interests, and devoted to the public wants under the supervision of its own appointed authorities. Now that we are free from any of the grand necessities of war, our public credit has risen to an extent unprecedented, and nothing restrains us in the application of our immense resources to every thing which may increase the national wealth and confirm the happiness and prosperity of France.

The statements, which have just been made by your President, which were heard with so much pleasure, are a further proof of the confidence which we ought to place in the future; it will not be stationary.

Our progress, however great it may be, will not rest where it is. To what extent will it go? I know not, and think that no one can foresee or calculate the flight which the national genius imprints upon the conquests of industry and public wealth,—those conquests by which none are despoiled, no personal rights violated, and no tears caused to be shed. This is what we desire,—this is what we are pursuing. We shall continue to respect the independence of our neighbours, as they will respect ours. The victories which France has so often attached to its flag are pledges, as certain as they are glorious, of our repose and our safety. It is by persisting in this salutary path that we shall behold our commerce and industry increasing by the stability which peace affords, and the confidence which foreign nations will place in our productions, when we furnish them frankly and loyally always satisfying ourselves with a moderate profit. They may see in our expositions the manner in which French manufacturers direct their labour. To them they will furnish an example;—to us a pleasure. I was anxious to be once more amongst you, to repeat to you how sensible I am to the testimonies of affection which I have received in the numerous visits I have made to the exposition. I regret that it is over, since I shall be deprived of the opportunities of meeting with you, of hearing you, and discoursing with you.

Recueil Soc Polytech.

Means of Preserving Cordage, Cloth, and Nets.

Fishermen on the English coast use the following method:

For one pound of thread take tan of good quality, two pounds. Boil in a suitable quantity of water six hours.

Let the tan boil alone during the first hour in a moderate quantity of water, and then put in the stuff, adding more water and keeping up the ebullition by a great heat. The stuff should not touch the sides of the kettle.

Articles thus tanned will last many years, especially if steeped once a year when they are much used. Ibid.

To determine whether Flannel contains Cotton.

Take a given weight of the flannel, 10, 20, or 30 parts, and boil it in strong ley, or solution of potash, the flannel soon dissolves and is converted into soap, while the cotton is but slightly altered. The insoluble residue (the cotton) is washed, dried and weighed, and thus its proportion of the tissue is ascertained. Ibid.

Progress of Physical Science.

*Abstract of the Proceedings of the Physical Section of the British Association for the Advancement of Science.**

"On a Blue Sun seen at Bermuda."

On the 11th of August, 1831, this curious phenomenon was observed. Not only the sun appeared of a blue colour, but white objects, such as the sails of vessels, were similarly tinged, and the sea appeared of a dingy yellow. On the day when these observations were made at and near Bermuda, a hurricane was passing over St. Vincent. Sir David Brewster, to whom these observations were communicated by Lieut. Col. Reid, Governor of Bermuda, attributes the colour to the interposition of vapour or of vesicles of water, between the eye of the observer and the sun, and remarks that the same cause may produce other colours; he had, for instance, once observed the sun to be of a salmon colour,† in which both yellow and red were mixed with blue. The phenomenon is analagous to that of the colours in sulphate of lime and other minerals containing strata of minute cavities filled with fluids; the colours resulting from diffraction at the edges of the transparent bodies, separating media of different densities.

Results of Hourly Meteorological Observations.

These observations were made at Inverness and Kingussie, under the direction of Sir David Brewster, by competent observers, and

* From the report of the proceedings given in the London Athenæum, for Oct., 1840.

† Early in August, 1831, though I cannot now fix the date, the sun was seen of this colour for some days in succession along the Atlantic Coast. [A. D. B.]

with standard instruments. In reporting upon them, SIR DAVID BREWSTER remarks, that "when these observations are compared with those made at Leith, under my superintendence for four years, with those made at Plymouth from 1832 to 1840, at the expense of the Association, and under the able superintendence of MR. SNOW HARRIS, and with those made at Padua, Philadelphia,* and in Ceylon, we perceive very distinct traces of meteorological laws, of which no idea had been previously formed; and I have no hesitation in stating that when this class of observations are multiplied and extended, they will lead to general results of as great importance in predetermining atmospherical changes, as those which have enabled the astronomer to predict the phenomena of the planetary system."

The mean value of the interval between the times of the morning and evening temperatures which correspond to the mean of the day, deduced from the average of nine stations, is eleven hours and five minutes.

The curious result is derived from these meteorological observations that the periods of calm and of minima of temperature correspond to each other, and that the force of the wind depends on the average elevation of temperature.

Force of the Wind.

MR. OSLER, of Birmingham, communicated the results of observations on the force of the wind recorded by his anemometer,† during the years 1837, 8, and 9. It appears from the average of more than one thousand observations made for each hour of the day, that if a curve be traced to represent the mean of the force of the wind for each hour, it will be almost exactly the reverse of the curve of mean temperature for the day, not only for the whole year, but for each season.

Hourly Meteorological Observations in India.

MR. CALDICOTT gave an account of the observatory erected at Trevandrum, by the Rajah of Trevancore, one of the native Indian Princes, and of the instruments already placed, and of those which he had been already authorized to place there. The hourly meteorological observations have been made since June, 1837.

The registers of the barometer give the times of maxima of daily pressure between the hours of 9 and 10, A. M. and P. M., and of minima between 3 and 4, P. M. and A. M.

Fall	of the barometer	between	10 A. M. and 4 P. M.	0.109 inch.
Rise	"	"	4 P. M. and 10 A. M.	0.108 "
Fåll	"	"	10 A. M. and 4 A. M.	0.071 "
Rise	"	"	4 A. M. and 10 A. M.	0.073 "

* At Frankford Arsenal, under the direction of Captain Mordecai. See this journal, vol. xix. p. 7.—[A. D. B.]

† One of these admirable instruments has been mounted, under my charge, in the Philadelphia Magnetic Observatory, and its registers preserved since June, 1840. [A. D. B.]

Tides in the German Ocean.

The curious feature shown by the Rev. Prof. WHEWELL, in his map of co-tidal lines, in regard to the tides of the southern parts of the German ocean, is stated by him to have been recently confirmed by observation. He had found that the tide wave there, must have a rotary motion, traveling southwards along the coast of Norfolk and Suffolk, England, then crossing over to the coast of Holland, and traveling along that coast from south to north. Hence it follows that at a certain point of the sea between England and Holland there is *no tide*, the surface neither rising nor falling. Capt. HEWITT, in his recent survey of the German ocean, has found a place where the rise and fall in the twenty-four hours is so small that it may be considered as not existing.

Photogenic Drawing.

Professor SCHÄFTHAEUTL, of Munich, described his mode of obtaining photogenic drawings resembling those of Mr. TALBOT, where the lights are represented by shadows, and also two new methods of procuring drawings similar to those of the Daguerreotype, in which the lights and shades are represented as in nature. The first is on paper, prepared as follows. A concentrated solution of nitrate of silver is made by dissolving 140 grs. to 2½ drachms of fused nitrate in 6 fluid drachms of distilled water, and placed in a large dish, and the paper drawn over the surface of the solution. The nitrate taken up by the paper is converted into chloride by exposure to the vapour of boiling muriatic acid. This chloride has a peculiar silky lustre. The sensibility of the paper is increased to the highest point possible by again drawing it over the surface of the solution of the nitrate of silver and then drying. To fix the drawing obtained upon this paper, it is steeped for five or ten minutes in alcohol, the superfluous moisture removed by blotting paper, and then slightly dried before the fire. It is next drawn through diluted muriatic acid, to which a few drops of acid nitrate of mercury have been added; well washed in water, and dried at a temperature of about 158° Fah. The addition of the nitrate of mercury requires great caution, because if added in too great quantities the lightest shades disappear entirely; hence the proper action of the solution should be ascertained by trial upon small slips of prepared paper, which have been exposed to light.

To obtain the second kind of drawings above referred to, Dr. Schafthaeutl employs one or other of the following means. The paper which has just been described is allowed to darken in a bright sun light, and is then steeped for at least half an hour in a solution made by adding one part of the solution of the acid nitrate of mercury to nine or ten of alcohol. A bright lemon-coloured precipitate is thrown down, and the clear liquid is preserved for use. The paper which has been thus steeped is removed from the alcoholic solution and quickly drawn over the surface of dilute muriatic acid, prepared

by adding one part of strong acid to seven or ten of water, then quickly washed in water, and slightly and carefully dried in a temperature not exceeding 212° Fah. The paper is now prepared for bleaching by light, and the drawing may be fixed by steeping in alcohol which removes the free bi-chloride of mercury. This last maceration must not be continued too long, as in that case the paper begins to darken again.

On the decomposition of Glass.

Sir David Brewster finds by the application of refined optical experiments, that glass is subject to two kinds of decomposition. In the first the decomposition commences in joints and extends itself either in planes so as to form thin films, or in concentric coats so as to form concentric films. When the centres of decomposition are near each other, the concentric films, or strata which they form, interfere with each other, or rather unite, and the effect of this is that the glass is decomposed in films of considerable irregularity, their surfaces having a finely mamillated appearance, convex on one side and concave on the other. These films afford, by transmitted light, colours of infinite beauty and variety, surpassing any thing produced by art. They separate the compound solar spectrum, sifting, as it were, the mixed colours, as is done by coloured and absorbing media. In the other kind of decomposition the silicious and metallic components of the glass are separated, the particles of silex arranging themselves around the centres of decomposition, in alternating spheres with the metallic particles.

Preservation of Glass.

M. Lamont, director of the Observatory of Munich, states that the surface of glass lenses and prisms may be effectually preserved from the spots resulting from superficial decomposition to which it appears that Fraunhofer's glass is particularly subject, by rubbing the surface frequently with the finer parts of whiteing prepared by working a mass of whiteing in water, the fine powder thus obtained being used on old and soft linen.

Quantity of Rain at different Heights.

Professor Phillips found in a series of experiments continued from June 1st to September 3d, inclusive, that the quantity of rain collected at heights above the ground, increased by three feet at a time up to twelve feet, diminished on the average with the increase of height.

New Rain Gauges.

Professor Phillips has invented a gauge for measuring the direction from which a rain comes and the inclination of the drops. It con-

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ıd horizontal aperture, the other four tubes secured so as to present
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In all, the author has observed seventy-one different microscopic calcareous and silicious species of animals in the chalk; but, besides these,

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also numerous larger calcareous animals (1-24th of a line in size) and many included plants, Tethyæ, Sponges, Confervæ, and Fuci. The varied forms of the genera *Rotalia,* and *Textularia* of the Polythalamiæ, appear to him to constitute the great mass of the chalk of all localities. He reckons altogether seven genera and twenty-two species of polythalamic microscopic calcareous animals; and, moreover, microscopic and larger nummulites, cypridæ, &c. Further, he has hitherto determined forty species of siliceous infusory animals which belong to fourteen genera, without including the eight forms previously enumerated, and which were probably soft, and merely included in flint. He has found five species of plants containing silica. In the flints of the Jura limestone of Cracow, he detected well preserved peculiar Polythalamiæ, and remains of Sponges or Tethyæ; and lately, he has found Polythalamiæ of the chalk in the flints occurring in the gault which lies under the chalk at Cambridge in England.

A general table of these relations of the animals from the chalk and chalk-marl of the fourteen localities observed by him, and also specimens of the rocks, together with a collection of well-preserved microscopic preparations, containing nearly a perfect series of the different species of animalcules, were exhibited to the Royal Prussian Academy.

To this paper Professor Ehrenberg added a preliminary summary of his examination of the Spiral-corals or Polythalamiæ, considere d in a zoological point of view. Edinburgh Philos. Jour.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE. BY J. GRISCOM.

Account of a Whirlwind, accompanied by immense Electrical discharges, in the commune of Chatenay. By M. Peltier.

M. Peltier gave an account of a whirlwind (trombe,) which devastated the commune of Chatenay (Seine-et-Oise,) on the 18th of June last, the cause of its formation, its origin, its progress, deviations, effects and termination. After mentioning the persons who accompanied him in the examination of the region of the storm, and of the numerous persons who had witnessed it, he says:

Early in the morning a storm had gathered to the south of Chatenay, and by ten o'clock had advanced into the valley between the hills of Econen and the mount of Chatenay. The clouds were pretty high, and having extended over the village, they stopped, and the storm appeared likely to spend itself in the plain at the west, covering Chatenay only by its eastern extremity. The thunder rolled, and this first gust followed the commune track, when about noon a second gust arose also in the south, and rapidly advanced up the same plain. When it reached the extremity of the plain over Fontenay and had attained a position near the first gust which towered above the second by its greater elevation, it was arrested, and the spectators were left in doubt with respect to the direction it would be obliged to take. The thunder was heard from this second storm, when suddenly one of its lower clouds descended to the earth, and all explosion appeared to cease. A prodigious attraction now took place. All the light

bodies on the surface of the ground flew up with the dust to the point of the cloud; a continual rolling sound was heard, little clouds fluttered and whirled round the inverted cone, ascending and descending rapidly. One observer, favourably situated, saw the cone ending below in a cap of fire, while another who was on the very spot enveloped in the whirlwind of dust saw nothing of the fire. The trees situated on the south-east of the whirlwind were attacked by it on their north west side which faced it; the other half or side was preserved from its violence. The exposed side of each tree was much blasted, while the other portion retained their sap and vegetation. The whirl descended the valley to the extremity of Fontenay, and tearing up and destroying some trees which grew on the borders of a brook, which, though without water, was still moist, it crossed the valley and destroyed another plantation of trees. Here it stopped a few minutes (one person said ten minutes) as if uncertain which way to proceed, having attained a position beneath the first thunder clouds, which, though till then stationary, began to move, being repelled by the whirlwind, retrograded down the valley to the west of Chatenay. The storm closed, arrested as we have said, over the plains of Thibaust, after drying up, destroying and devastating this whole plain, advanced to the park of the Castle of Chatenay, overturning every thing on its way. Here on the mount it filled with desolation one of the most delightful habitations in the vicinity of Paris. The park lost all its finest trees. The newest plantations just beyond the verge of the storm, are all that remain; the walls were thrown down, the castle and the farm house lost their roofs and chimneys, trees were transported to the distance of several hundred yards, while rafters, staffs, tiles, &c., were carried more than five hundred. Passing from the mount, the tempest stopped over a pond, tore up and destroyed one-half of the trees, killed all the fish, moved slowly along an avenue of willows, whose roots extended into the moist ground; losing, in this place, much of its extent and violence, it advanced still more slowly along the plain, and at a thousand yards from Chatenay, near a grove of trees, it divided into two parts, the one rising into the upper regions of air, and the other becoming extinct near the surface.

In this too rapid statement, continues M. Peltier, I have designedly omitted to speak of the condition of the trees. All those which were struck by the storm presented the same appearances. Their sap was all evaporated, the ligneous fibres had lost their cohesion, and were dried up, as if they had been exposed for forty-eight hours in an oven to a heat of 300° Fah. Not a vestige of moisture remained. This immense quantity of vapour, instantly disengaged, could be liberated only by breaking the trees to pieces, and exposing all their vessels, and as the ligneous fibrils were less coherent in this longitudinal and then horizontal direction, the trees were all split into lath throughout a portion of their trunks. Fifteen hundred feet attested that they had served as conductors to masses of electricity, to continual and incessant strokes of lightning, and that such an elevation of temperature was produced by this continuous electric current as to vaporise almost instantly the whole of the moisture of these vegetable conductors.

This immediate vaporisation caused the wood to split longitudinally, and the trees, when dried, split and converted into bad conductors, were by the agitation which accompanied the storm, broken to pieces instead of being torn up by the roots.

In tracing the progress of this phenomenon, we witness the transformation of a common storm into a whirlwind. We perceive two storms near each other, the one above motionless, the other below presenting itself by clouds charged with the same electricity, the first storm repelling the other toward the ground, the clouds at the head of the second lowering and communicating with the ground by whirlwinds of dust and by trees. Thus connected, the noise of the thunder immediately ceases, the discharges occurring through the descending clouds and the trees of the plain. The latter becoming the channels of the electric current, are so heated that their sap is instantly reduced to vapour, and the trees are lacerated by the tension. Flame balls, and sparks of fire, accompanied the meteor. The odour of sulphur was perceived on some of the houses for several days, and curtains even changed in colour. Every thing tends to prove that the whirlwind was only a cloudy conductor; serving as a passage for the continuous discharges of the upper clouds; and that there is no other difference between a common thunder gust and a gust accompanied by a whirlwind, than this additional conductor which conveys the whole action of the storm to the point between the whirlwind and the ground beneath.

L'Institut p. 290.

Account of a Storm near Brussels, on the 4th of June, 1839. *By* M. Quetelet.

A storm occurred on the 4th of June, 1839, in the vicinity of Brussels, in which, according to M. Quetelet, so much rain fell as to produce an inundation, which caused the death of thirty-nine persons. It is thought the devastation must have been occasioned by a water spout.

The quantity of rain collected at the observatory at Brussels, on that day, was 112.78 millemitres, ($4\frac{1}{2}$ inches) which is one sixth of the quantity which fell annually at that place. So great a quantity of rain was never known before to fall at once. The most copious rain before recorded, in twenty-four hours, was on the 7th of July, 1833, the quantity being 50.27 millémitres. This last storm lasted but three hours. The barometer stood at 747.40 min. = 29.43 inches.

M. Quetelet describes a halo which appeared on the 2nd of June, at Brussels, accompanied by parhelia. It continued from half-past eleven until evening. Its colour was of a deep greyish blue, and the radius measured, about six o'clock, 22° 27′. M. Willaert, Professor at Alost, saw the primitive halo separate into two parts, the interior one being very well formed, the exterior very faint. The radius of the small circle was 22° to 20°, and that of the larger about double.

At the same time, two parhelias were formed on the circumference of the interior circle. One of the sun's images was on the southern extremity, and the other on the northern of the diameter, which passed

through the sun. The southern image emitted groups of luminous rays, which, at intervals, had the appearance of a luminous cross.

Ibid p. 286.

Rupture of a Chain by Lightning.

The Hotel of the Invalides at Paris, was struck by lightning, and according to M. Bugnot, the inspector of the buildings, a chain which had served as a portion, at least, of the conductor, in consequence of having been wound round an iron support, in order that its weight might not bear too hard on the sustaining point, was broken by the lightning, and the fluid passing off on a tangent, struck the building so violently as to throw off enormous stones to the distance of eighteen or twenty yards. This fact indicates the propriety of avoiding, in all lightning rods, turns or inflexions of too sharp an angle. Similar facts, it appears, are mentioned by some ancient authors. Ibid.

Progress of Civil Engineering.

Notes on Artesian Wells and Well Boring in France.

FROM FRENCH PUBLICATIONS.

M. Champoiseau has communicated to "the Academy of Sciences," the result of the experiments which he made at Tours, to ascertain the relation which existed between the water of his artesian well, and that of the neighbouring rivers. These experiments were continued for more than three months (March, April and May), and did not show any variation in the produce at any time, whatever were the variations in the rivers round Tours, or in the tides; neither was the limpidity of the water at all affected. Indeed the apparatus did not exhibit any sensible change in the well water, and the conclusion drawn is that the artesian wells of Tours, from the great elevation of their feeding springs, are not exposed to the irregularities observed elsewhere.

A singular circumstance recently occurred during the construction of the Left Bank Versailles Railway, near Val de Fleury, varying in its operation, and its treatment, from some similar instances, which occurred on the London and Birmingham, and other railways here. A large embankment was in progress to join the viaduct then building, but the deposit of earth had scarcely begun when an extraordinary motion was communicated to the adjoining soil. In two places it was lifted up eight or ten yards above the surface, the road was blocked up, and several houses on the disturbed site were upset. It was found that this operation proceeded from a stratum of clay, mixed with sand, and soaked with last year's rains, so as to become fluid; that the weight of the embankment, thirty yards high, and that of the superincumbent strata had put this pulpy mass in motion, and that it had disturbed the adjoining soil on the slope of the valley, and had in several places lifted up and broken through the upper strata. The

cause was apparent that water did the mischief, and though it might not have shown itself immediately if the season had been dry, yet ultimately it would have been productive of serious evil. To remedy this, there were no other means than to stop the flow of water arriving from the upper levels; to carry which into effect it was necessary to cut the clay stratum and replace by stone work, which would surround the site on which the embankment was to be formed, and divert the water. This operation was found exceedingly difficult, having to be carried on at a depth of from six to twenty yards in a moving soil, saturated with water; it was long, very dangerous, and an accident might have wasted much valuable time, the works of the embankment being suspended in the meanwhile, and the stone-work itself being liable to be swallowed up in a few years, and the work to be done over again.

Under these circumstances, the engineers thought it advisable to have recourse to boring for the purpose of absorbing the water, and applied to the General Well-boring Company at Paris. This mode was also difficult, as the boring tube got plugged up in the soft stratum as fast as it was emptied, but by means of good tools this was at last got over. The first boring reached twenty yards, and got into the upper part of the chalk, notoriously full of fissures, and where the water was rapidly absorbed. The second and third borings were carried to thirty-five and forty yards in order to get at the chalky fissures which communicate with the Seine, and feed the neighbouring wells. A series of borings will therefore be carried round the embankment at proper distances and drains if necessary made to carry the water into the borings, which can easily be kept clear by means of a valve and cord. It is proposed also to apply this method to get rid of the water in sand, but this necessarily depends on the strata, for we believe that in the Kilsby tunnel it would not have been practicable.

Civ. Eng. and Arch. Jour.

Improved Railway Wheels.

Mr. Dircks, of Liverpool, gave an account of his improved railway wheel. The wheel may be made either of wrought or cast iron—that exhibited in the model room is of cast iron, and is one of the set of four wheels, which have run daily on a railroad for the last two months, carrying an average load of five tons, and are considered, by competent judges, to be better, if any thing, now than the first day they were put on the road. The construction of the wheel will be understood by imagining an ordinary spoked wheel, but with a deep *channeled* tyre. In this channel is inserted blocks of African oak, measuring about four by three and a half inches—prepared by filling the pores with unctuous preparations, to render it impervious to wet or dampness, by thus counteracting the effects of capillary attraction. The blocks are cut so as to fit very exactly with the grain placed vertically throughout, forming a kind of wooden tyre. There are about thirty blocks of wood round each wheel, where they are retained in their

place by bolts—the two sides of the channel having corresponding holes drilled through them for this purpose—each block of wood is thus fastened by one or two bolts, which are afterwards well rivetted. After being so fitted, the wheel is put into a lathe, and turned in the ordinary manner of turning iron tyres, when it acquires all the appearance of a common railway wheel, but with an outer wooden rim, and the flange only of iron. Mr. Dircks proposes the use of either hard or soft woods, and of various chemical preparations, to prevent the admission of water into the pores of the wood; he also contemplates the using of wood well compressed. The several advantages which this wheel possesses are represented by him to be—that the wooden tyre will wear a considerable time without requiring any repair—that the tyre can be refaced by turning it up again in the lathe, as with worn iron tyres—that it can be retyred with wood, at little expense, and at a far less loss of time than usual—and that, both in the operations of refacing old tyres, or putting in new wood, the work can be performed without the usual labour and cost of removing the wheels from the axles, which, in keying and unkeying, is known to be very troublesome. In regard to their working, it is an opinion, in which Mr. Dircks said he was borne out by experiment as well as by the opinion of practical engineers, that it will work smoother and easier than iron tyred wheels, with the advantage of going well in wet weather and upon inclines—entirely obviating the necessity of dropping sand on the rails. One very important advantage yet remains, and that is, that the rails themselves will suffer less wear by using these wheels, and the fastenings, sleepers, and blocks not be so much injured; indeed, if they answer to the extent that seems to be with reason expected, it is possible that they will have the effect to bring cast iron wheels into more general use.

It is well known that a road laid on stone blocks is kept up at a lower rate than when laid on wooden sleepers, and the only reason for laying them aside, arises from the tremulous motion which iron wheels occasion on the rails. In most cases stone blocks are still used, where they can be applied with safety, in preference to wooden sleepers. On the Kingstown and Dublin Railway, the rails were originally laid on granite sleepers, but the tremulous motion just adverted to was so great, and likely to prove so disastrous, by loosening the rails, together with the consequent damage sustained by engines and carriages passing along the line, that they were ultimately all taken out to lay down longitudinal wooden sleepers. Now, there is every reason to believe, that in all such cases, the effect of these wood-tyred wheels would be, by obviating this injurious tremulous motion, to favour the continued employment of stone blocks in the laying of railways—an advantage, upon the importance of which, as being well understood, it will not be requisite to enlarge here. This new construction and simple adoption of wood makes excellent driving-wheels for locomotives. The wood by use becomes exceedingly close and firm, acquires a smooth surface, does not prevent the ringing of the wheels when hammered, and in outward appearance is not easily distinguished from metal.

Mining Review.

New System of Lockage for Canals.

To avoid the present expensive construction of locks and their waste of water, Mr. Smith, of Deenston, proposes to divide the canal into a series of basins, the water levels of which should be from 12 to 18 inches above each other. The extremity of each basin is so constructed as to permit only the free passage of a boat; in this is placed a single gate, hinged to a sill across the bottom, the head pointing at a given angle against the stream, and the lateral faces pressing against rabbets in the masonry. The gate is to be constructed of buoyant materials, or made hollow so as to float and be held up by the pressure of the water in the higher level; on the top is a roller to facilitate the passage of the boats. When a boat is required to pass from a higher to a lower level, the bow end, which must be armed with an inclined projection, depresses the gate as much as the depth of the immersion of the boat, and as much water escapes as can pass between its sides and the walls of the contracted part of the basin. The same action takes place in ascending, except that a certain amount of power must be expended to enable the boat to surmount the difference of level between the basins. The quantity of water wasted by each boat would be in proportion to its immersion and the speed at which it passed over the gate. In case of different sized boats passing along the same canal, it is proposed to have a small gate forming part of the main gate, so as to avoid the loss of water which would ensue from the whole width being open for the passage of a small boat. This system has only been tried by models; but it is proposed to make an essay on an extensive canal next summer, when the results will be communicated to the Institution.—*Trans. of Inst. Civ. Eng.* Mech. Mag.

Draining the Haarlem Lake.

M. Dietz, a celebrated Dutch engineer, has invented a machine which it is supposed will be adopted for this purpose, and by means of which he calculates that 100,000 cubic ells of water may be drained off daily. This ingenious person estimates the body of water contained in the Haarlem Sea, at 770,000,000 of cubic feet, to empty which it would require ten of his machines of 30 horse power each, the quantity drained off by them daily being 1,000,000 of cubic feet, thus making the period required for its entire removal 800 days. The estimated expenditure of this work, second only in grandeur and importance to the Thames Tunnel, is as follows:—

	Florins.
Ten machines, at 30,000 florins each	300,000
Coals, &c., 500 florins per diem for 800 days	400,000
Sixty workmen at 1½f. each per diem for 800 days	72,000
Superintendence, plans, &c.	25,000
Total, - - - - -	797,000
About - - - - -	£68,416

Report on a Pantograph, presented by M. Legey. *By* M. Francœur.

The pantograph is an instrument of the greatest utility in reducing drawings to smaller dimensions, and it is sometimes used in amplifying them or in copying them of the same size. But the uncertainty of the adjustments prevent entire confidence in the precision of the designs thus executed; and this instrument is rarely employed in cases where it is indispensable that the lines should be extremely accurate in this relation, particularly when the drawings are on a large scale.

The pantograph of M. Legey has the same form, and is founded on the same principles as those in common use; only he has applied to its execution all the care which his previous labours have rendered him so capable of. It would be too tedious to enter here upon all the details of the minute perfections to which he has brought its construction; we shall designate only the principal parts.

The branches of the instrument are not flat rulers in wood or brass, as heretofore, but tubes, bench drawn, which give to the system more lightness and solidity. These branches can no longer bend under their weight. Screws of adjustment render the plane of the instrument exactly parallel to that of the table which bears it. The rollers are disposed so as to support the instrument in the best manner in all its movements. The axis round which the principal points of junction are pivoted, though solidly arranged, are susceptible of receiving slight displacements in order to regulate the instrument; for we know that the branches must rigorously form a parallelogram in all their positions, and that the fixed points round which the rotation is made must be precisely on the right line passing through the pencil and the stylet which traces the drawing. The author has also designed to allow of slight movements to certain supports of the stylet and the crayon, in order that the straight line, either in one direction or the other, should be perpetually preserved; for we know that the precision of the result depends essentially on these conditions.

In conclusion, the pantograph of M. Legey appears to us to be executed with care, and formed upon the best principles. It is, moreover, of such large dimensions, that it has served to reduce the plan of the city of Arras, and produce a drawing of a metre and a half in width. The most favourable testimony has been furnished us in this respect by Captain Bichot, of the Engineers who performed the work.

Signed, Francœur, Reporter.

Bull. d'encour. Nov. 1839.

Mechanics' Register.

New Post Office Regulations in England.—Seeds sent by Post.

We have lately received not only seeds, cuttings, and scions, but even entire plants, and yesterday a shrub, roots and branches, (Vac-

cinium humifúsum), in a penny letter. From Messrs. Sang, of Kirkcaldy, we received a prepaid packet very neatly done up, containing the seeds of twelve kinds of annuals, each with the name printed, and the price of the whole twelve only 1*s*. If this does not lead to the general distribution of every useful and ornamental plant of which seeds are procurable, the fault will be in the public, not in government. We only wish that the foreign postages could be lowered a little, that our ornamental annuals might be sent all over the Continent; for, it is a fact that will not be denied, that annual plants, even those of warm climates, make a far more splendid appearance in Norway, Sweden, Russia, and the North of Germany, than they do in England, owing to the brighter sun and longer days of these countries during the summer season. Great part of the Californian annuals might be naturalised in the woods of Norway and Sweden, and many superior varieties of bread corn, and of pasture grasses and herbage plants, might be introduced into these countries by post, if the postage abroad were only a little lower. An interchange of seeds amongst all the curators of botanic gardens in Europe and America is a result to be anxiously desired, not merely by the botanist, but by the horticulturist and the farmer. If ambassadors were what they ought to be, matters of this kind would have been attended to long ago.—*Cond.*

Gard. Mag.

Southern Magnetic Expedition.—Extract of a Letter from an Officer of H. M. S. Erebus, 7th February, 1840.

"On the 20th November, we left Porto Praya, and December 2nd and 3rd examined and took observations on a cluster of rocks called St. Paul,—evidently the summit of a submarine peak. The sea would make a clear breach over them in blowing weather, consequently nothing vegetable is found. The geological specimens will prove interesting; their general character plutonic, with blue lava and conglomerate. Crabs and sea birds were breeding, and the rocks are quite white with the dung of the latter.

"December 17th we landed on Trinidad, to make magnetic observations, and December 24th we crossed the magnetic equator, in latitude 14° 1′ S, after which in the teeth of a S. E. trade, we worked up to St. Helena, having completed a chain of dips from England to that place.

"Perhaps the most interesting of our achievements will be the fact of our having gained bottom, at two thousand four hundred and twenty six fathoms, in latitude 27° 24′ S. longitude 17° 30′ W., both ships being becalmed on the edge of the S. E. trade. A line of 3600 fathoms of spun-yarn being prepared, a weight of 72 lbs. was attached to it, and two boats were lowered to buoy up the line. The first 100 fathoms took 35 seconds reeling off,—the last nearly 6 minutes; we lifted the lead more than once, but of course the spun-yarn broke in the attempt to haul it up." Naut. Mag.

To the Committee on Publications of the Journal of the Franklin Institute.

Gentlemen,—Mr. John Downes, of Worcester, Mass., having kindly offered to make the computations for the announcement of the Lunar Occultations of the fixed stars for the year 1841, I herewith forward you those for February, March and April, which have been calculated by Mr. Downes from a list selected by E. O. Kendall and myself. Mr. Downes is already favourably known as the computer of the Astronomical portion of the Boston Almanac. It is almost needless to add that his computations of the Lunar Occultations for January and February for Philadelphia agree precisely with those made for the same phenomena by Mr. Kendall and myself. As our other avocations render somewhat onerous the labour of making the announcements, which was sustained by myself without aid from 1834 to 1836 —and since that date by Mr. Kendall and myself—our duplicate computations saving the necessity of a separate review,—we have gladly accepted the very disinterested offer of Mr. Downes, and would respectfully recommend his computations to the favourable notice of that portion of the readers of the Journal who are interested in kindred pursuits.

Yours respectfully,
Sears C. Walker.

Philadelphia, December 30th, 1840.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right, or westward, round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
4	16	34	Im. δ Cancri	4.5	19°	73°
4	17	13	Em.		287	340
5	18	30	Im. 18 Leonis,	6	13	64
5	19	2	Em.		294	343
MARCH, 1841.						
1	6	0	Im. C Tauri,	4.5	142	117
1	6	26	Em.		200	169
9	14	25	N. App. ☽ & 75 Virginis 6, ☽ south 1′.1			
25	20	18.82	Im. Venus. External contact.		130	79
25	20	19.73	" " Internal "			
25	21	10.87	Em. " " "		275	221
25	21	12.82	" " External "			
26	7	42	N. App. ☽ & 7 Tauri 6, ☽ south 0′.5			
29	12	19	Im. 37 Geminorum,	6	117	176
29	13	6	Em.		210	260

LUNAR OCCULTATIONS FOR PHILADELPHIA, APRIL, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
2	8	42	Im. 48 Leonis,	5.6	104°	83°
2	9	30	Em.		181	177
13	15	47	Im. 4 Capricorni,	6	154	120
13	16	50	Em.		247	225
14	8	58	Im. θ Capricorni,	5.6	67	116
			Em. below the horizon.			

Meteorological Observations for November, 1840.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	36	52	30.00	30.05	W.	Moderate.		Clear—do.
	2	39	52	.20	.26	N E.	do.		Clear—do.
	3	36	56	.20	.08	E.	do.		Clear—do.
	4	46	59	29 98	29.98	N.E.	do.		Hazy—do.
	5	39	58	.95	.90	N.E.	do.		Hazy—do.
	6	41	50	.86	.86	W.	do.		Partially cloudy—do.—do.
	7	41	63	.90	.95	W.S.E.	do.		Clear—do.
◯	8	44	49	.84	.76	E.	do.	.26	Cloudy—rain.
	9	46	48	.70	.64	W.	Brisk.		Cloudy—do.
	10	48	54	.70	.76	N.W.	do.		Cloudy—clear.
	11	38	52	.90	.90	N.W.	Moderate.		Clear—do.
	12	42	52	.80	.80	W.	do.		Cloudy—clear.
	13	40	53	.75	.75	W.	Brisk.		Clear—do.
	14	34	50	.90	.85	W.	Moderate.		Hazy—do.
	15	44	44	.50	.50	W.	Brisk.		Cloudy—do.
☽	16	33	42	.75	.80	W.	Moderate.		Partially cloudy—do.—do.
	17	29	40	.75	.80	W.	do.		Partially cloudy—do.—do.
	18	32	32	.76	.50	N.E.	do.	.50	Snow—do.
	19	30	56	.56	.60	W.	do.		Cloudy—do.—do.
	20	34	40	.85	.90	W.	do.		Clear—do.—do.
	21	26	42	30.05	30 05	W.	do.		Clear—lightly cloudy.
	22	36	43	29.90	29.75	S.E.	do.	1.65	Cloudy—rain.
⊗	23	56	52	.40	.40	S.W.	Brisk.		Cloudy—flying clouds.
	24	35	46	.95	.96	W.	Moderate.		Clear—do.
	25	36	44	.90	.80	N.E.	do.		Cloudy—rain.
	26	36	40	.60	.60	W.	do.	.34	Cloudy—snow.
	27	30	37	.86	.94	W.	Brisk.	.20	Clear—do.
	28	28	44	30.05	.97	W.	Moderate.		Clear—do.
	29	36	52	29.94	.58	S W.	do.		Clear—do.
	30	46	35	.70	.65	S.W.	do.		Cloudy—hazy.
	Mean	36.77	78.55	29.81	29.79			2.95	

	Thermometer.		Barometer.
Maximum height during the month.	60 00	on the 2nd.	30.26 on the 2nd.
Minimum " "	26 00	on the 21st.	29.40 " 23rd.
Mean	57.66		29.80

S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
5⅓	1⅓	2	1⅔	4⅔	⅔	.	1⅓	....	.	....	....	.	1182
8	.	1⅔	⅔	8⅔	.	.	1	....	.	.....	....	.	1176
·8	.	.	.	8	.	.	4	....	.	.....	....	.	1164
·4	.	7⅓	1⅓	2⅓	.	.	7⅓	....	.	.....	....	.	1174
·6⅓	.	3	.	3⅔	⅓	1⅓	⅓	....	.	......	....	.	1159
.	.	.	.	.	.	.	.	....	.	......	....	.	1173
·3	.	7	⅓	7⅔	⅔	6⅓	.	....	.	.....	....	.	1205
·4	.	3⅓	3	10⅓	.	⅓	3	....	.	......	....	.	1158
·5⅓	⅔	2	⅔	6⅓	⅓	.	2⅔	60.04	1	.....	....	.	1171
·2	1⅓	⅔	⅔	6⅓	⅓	.	⅔	68.08	2	.....	70.74	2	1181
·5	.	6	.	7	.	.	1	63.20	1	.....	....	.	1150
·.	.	5⅓	⅓	5⅓	⅓	1	2⅓	....	.	.....	72.14	3	1151
·1⅔	.	2	.	2⅓	.	15⅓	4	....	.	.....	....	.	1180
·1	.	5	1⅓	1⅔	.	5⅓	⅓	....	.	.....	....	.	1212
·0	.	21	.	.	.	.	⅔	....	.	.....	....	.	1192
·0	⅓	4⅓	⅔	3⅔	.	4⅔	8⅔	....	.	.....	....	.	1168
·8⅔	.	13	.	2⅔	.	.	2⅔	....	.	.....	75.57	1	1204
·7⅓	1⅓	5⅔	⅔	6	1	6	3⅓	....	.	.....	...	.	1154
·9⅓	6	1	11⅓	1⅔	⅓	.	⅓	....	.	.. .	....	.	1152
·6⅔	1⅓	4⅔	1⅓	⅔	.	11⅔	1	....	.	.....	....	.	1161
·4	.	6⅔	.	5	.	12⅓	.	....	.	...	....	.	1163
·5	.	⅔	.	2	.	14	.	....	.	....	....	.	1169
·7⅔	.	.	.	9⅓	.	.	16⅔	....	.	.....	....	.	1162
·6⅓	.	5⅔	.	4⅓	.	4	.	....	.	.....	....	.	1269
·8	.	10	⅓	3⅔	.	6⅓	⅔	65.03	11	......	70.11	13	1157
·14⅓	⅓	1	1	13	.	9	⅔	....	.	.....	....	.	1229
·60⅓	.	14	.	2⅓	.	.	.	....	.	.....	....	.	1153
·48⅓	.	5⅔	⅓	6	.	2⅔	1⅔	....	.	.....	....	.	1170
·04⅔	⅓	5⅓	2	3	.	4⅓	.	....	.	.....	....	.	1179

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA.

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JULY, 1840.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1 Philadelphia.	Philadelphia.	J. M. Hamilton,	74.86	79.27	73.83	88.00	66.00	75.89	1	58.00	67.14	9
2 Montgomery.												
3 Bucks,	Newtown.	L. H. Parsons,	73.10	80.20	67.10	88.00	59.00	73.47	⅓	50.00	59.50	.
4 Lehigh.												
5 Northampton,	Easton.	Charles Elliot,	67.50	76.83	69.10	88.00	60.00	71.14	1⅓	....	....	.
6 Monroe,	Stroudsburg,	A. M. Stokes,	73.96	81.89	70.00	90.00	52.00	75.28	12	....	....	.
7 Pike,	Milford,	Ralph Bull.	69.19	75.87	65.45	87.00	46.00	68.17	.	46.00	58.55	.
8 Wayne,	Honesdale,	W. Richardson,	63.64	81.64	63.85	89.00	52.00	69.71	17	50.00	56.12	23
9 Susquehanna.	Silver Lake.	E. Rose.	66.94	78.06	68.39	94.00	58.00	71.13	.	44.00	59.00	.
10 Luzerne.	Wilkesbarre.	W. F. Dennis,										
11 Schuylkill.												
12 Berks.	Reading.	C. F. Egelmann,	71.82	77.29	68.50	86.00	56.00	72.54	3	...	...	.
13 Chester.												
14 Delaware.	Haverford.	Haverford School,	71.81	79.31	71.66	88.00	59.00	74.26	1⅓	58.00	66.00	1
15 Lancaster.	Lancaster,	Conservatory of Arts,	69.63	81.98	71.13	92.50	60.00	74.25	⅔	54.00	65.79	.
16 York,												
17 Lebanon.												
18 Dauphin.	Harrisburg,	J. Heisely,	73.20	81.27	77.55	90.00	63.00	77.34	1	59.00	68.60	1
19 Northumberland.	Northumberland,	Andrew C. Huston,	70.10	78.95	72.02	89.00	63.00	73.69	2⅔	46.00	58.62	2
20 Columbia.	Danville,	C. H. Frick.										
21 Bradford.												
22 Tioga.												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata.	Mifflintown.	J. A. Rinkead,	62.40	81.30	67.38	90.00	51.00	70.36	3⅓	....	....	.
27 Perry.												
28 Cumberland.	Carlisle,	Prof. W. H. Allen,										
29 Adams.	Gettysburg,	Prof. M. Jacobs,	68.13	82.26	71.25	94.00	53.75	73.88	.	50.00	61.64	.
30 Franklin,												
31 Huntingdon.	Huntingdon,	Jacob Miller,	68.00	83.13	70.77	90.00	58.00	73.97	⅔	....	....	.
32 Centre,	Bellefonte,	John Harris,	66.31	83.11	68.80	90.00	51.00	72.74	7⅔	....	....	.
33 Potter,												
34 M'Kean,	Smithport,	Richard Chadwick,	61.48	79.81	60.03	93.00	42.00	67.11	.	59.00	53.77	.
35 Clearfield.												
36 Cambria.	Ebensburgh,	Richard Lewis,	62.21	78.52	63.87	89.00	52.00	68.20	3⅓	44.00	55.59	4
37 Bedford.	Bedford.	Samuel Brown,	71.60	80.54	72.11	90.00	62.00	74.75	⅓	....	....	.
38 Somerset.	Somerset,	George Mowry,	62.79	74.31	63.20	83.50	51.50	66.77	⅔	44.00	56.76	.
39 Indiana.	Indiana.	Richard White,	73.71	79.13	66.84	90.00	57.00	73.23	.	59.00	50.60	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,	66.26	76.52	72.89	85.50	54.00	71.89	.	53.00	65.71	.
42 Venango,	Franklin,	Wm. Connely,	67.81	84.55	66.16	102.	40.00	69.51	.	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette.	Uniontown,	J. P. Weithers,	69.29	85.10	69.79	98.00	55.00	74.73	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	A. H. Campbell,	64.81	77.94	70.58	88.00	53.00	71.11	.	50.00	61.47	3
48 Allegheny,	Pittsburgh,											
49 Beaver,	Beaver,	Wm. Allison,	69.06	83.79	71.94	95.00	60.00	74.93	⅔	....	....	.
50 Butler,	Butler,	Jacob Mechling,	66.26	80.00	72.35	90.00	56.00	72.87	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,	71.48	78.62	69.13	88.00	60.00	73.08	1⅓	50.00	62.55	.
53 Erie.	Erie,	Park & Reid,	71.21	76.42	69.03	91.00	55.00	72.22	.	48.00	60.23	.

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia.	30.11	30.14	30.13	30.43	29.79	30.13	⅔	15⅔	11	4⅓	....	....	....	..	....
3 Bucks,	30.04	30.02	30.02	30.21	29.70	30.03	⅓	19⅓	10⅔	1⅓	7	....	....	..	3.983
5 Northampton,	29.97	29.96	29.95	30.18	29.60	29.96	1⅓	.	.	.	....	....	....	..	......
6 Monroe,	29.59	29.62	29.58	29.80	29.25	29.60	11⅔	7⅔	11⅓	12	10	....	....	..	4.770
7 Pike,	29.60	29.60	29.60	29.84	29.24	29.60	⅓	17	13⅔	⅓	10	....	....	..	3.658
8 Wayne,	28.89	28.91	28.89	29.05	28.60	28.90	17	.	.	.	....	....	....	..	......
9 Susquehanna.	28.12	28.12	28.12	28.35	27.70	28.12	.	22	9	.	7	....	....	..	2.510
12 Berks.	29.92	29.89	29.88	30.10	29.56	29.90	3	13⅔	14⅓	3	5	....	....	1	2.630
14 Delaware.	29.57	29.56	29.57	29.80	29.26	29.57	⅔	17⅓	13⅔	.	4	....	....	..	3.229
15 Lancaster.	29.57	29.56	29.56	29.79	29.20	29.56	⅔	19	11⅓	⅔	5	....	....	..	1.530
18 Dauphin.	29.78	29.79	29.79	29.97	29.50	29.79	1	.	.	.	....	....	....	..	......
19 Northumberland.	29.52	29.50	29.49	29.75	29.14	29.50	2⅓	13	15⅓	2⅔	7	....	....	3	1.937
26 Juniata.	29.54	29.48	29.52	29.73	29.16	29.51	4⅔	17	9⅓	4⅔	....	....	....	..	......
29 Adams.	29.45	29.44	29.44	29.65	29.17	29.45	.	21	9⅔	⅓	5	....	....	..	0.998
31 Huntingdon.	29.43	29.40	29.40	29.62	29.06	29.41	⅔	23	8	.	4	....	....	..	0.942
32 Centre,	29.33	29.32	29.30	29.50	29.02	29.32	7⅔	16	7	8	5	....	....	..	3.527
34 M'Kean,	28.07	28.08	28.07	28.28	27.80	28.07	.	12⅓	18⅔	.	6	....	....	..	2.409
36 Cambria.	28.00	27.99	27.98	28.22	27.70	27.99	3⅓	11	14⅓	5⅔	9	....	....	..	3.229
37 Bedford.	29.29	29.28	29.27	29.50	28.94	29.28	⅓	15	15⅔	⅓	....	....	....	..	......
38 Somerset.	27.93	27.93	27.93	28.10	27.64	27.93	⅔	11⅔	18⅔	⅔	6	...	....	1	3.350
39 Indiana.	28.70	28.68	28.70	28.90	28.40	28.70	.	19⅓	11⅔	.	10	....	....	..	3.900
41 Warren,	28.92	28.91	28.91	29.15	28.55	28.91	.	20⅔	10	⅓	6	....	...	..	3.849
42 Venango,	29.12	29.20	29.24	29.90	28.70	29.19	16⅓	12⅓	2⅓	16⅔	4	....	....	..	2.158
45 Fayette.	29.03	29.03	29.05	29.23	28.60	29.03	.	24⅔	6⅓	.	....	....	....	..	......
47 Washington,	29.13	29.16	29.15	29.40	28.82	29.15	.	.	.	.	7	....	....	..	3.772
49 Beaver,	29.50	29.48	29.47	29.75	29.14	29.48	⅔	18⅓	11⅔	1	6	....	....	..	1.810
50 Butler,	28.91	28.90	28.90	29.10	28.60	28.90	.	.	.	.	7	....	....	..	2.399
52 Crawford,	28.82	28.82	28.82	29.02	28.48	28.82	1⅓	15⅔	14	1⅓	8	....	....	1	4.054
53 Erie.	29.41	29.43	29.43	29.66	29.04	29.42	.	18	13	.	9	....	....	..	3.262

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia.	1	1	2	1	⅔	1⅓	1⅓	⅓	4⅔	⅔	5⅓	1⅓	2	1⅔	4⅔	⅔	.	1	....	.	....	....	.	[illegible]
3 Bucks,	⅓	.	5	.	⅓	⅓	1	⅔	1⅔	1⅔	8	.	1⅔	⅔	8⅔	.	.	1	....	.	....	....	.	[illegible]
5 Northampton,	1	.	2⅔	.	3⅓	.	4	.	.	.	8	.	.	.	8	.	.	4	....	.	....	....	.	[illegible]
6 Monroe,	1	.	.	.	2⅔	1	1⅓	.	2⅓	.	4	.	7⅓	1⅓	2⅓	.	.	7⅔	....	.	....	....	.	[illegible]
7 Pike,	1⅓	.	1⅓	⅓	1⅔	.	3⅓	⅓	7	⅓	6⅓	.	3	.	3⅔	⅓	1⅓	.	....	.	....	....	.	[illegible]
8 Wayne,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	....	....	.	[illegible]
9 Susquehanna.	.	.	2⅔	.	⅓	.	2⅔	.	⅓	.	3	.	7	⅓	7⅔	⅓	6⅓	.	....	.	....	....	.	[illegible]
12 Berks.	.	.	2	.	2⅓	⅓	1	.	1⅓	.	4	.	3⅓	3	10⅓	.	⅓	3	....	.	....	....	.	[illegible]
14 Delaware.	1	⅔	3	⅓	1	⅓	1	⅓	2	3⅓	5⅓	⅔	2	⅔	6⅓	⅓	.	2⅔	65.04	1	....	....	.	[illegible]
15 Lancaster.	2	1	2⅓	⅔	⅔	.	2⅓	2	6⅔	1	2	1⅓	⅔	⅔	6⅓	⅓	.	⅔	63.68	2	....	70.74	2	[illegible]
18 Dauphin.	3⅓	.	.	.	⅔	.	3⅔	.	4⅓	.	5	.	6	.	7	.	.	1	63.20	1	....	....	.	1152
19 Northumberland.	1	⅓	3⅓	.	⅓	.	3	.	8	.	.	.	5⅓	⅓	5	⅓	1	2⅓	....	.	....	72.14	2	1151
26 Juniata.	.	.	⅔	.	⅓	.	2⅓	.	⅓	.	⅔	.	2	.	2⅓	.	15⅓	4	....	.	....	....	.	[illegible]
29 Adams.	4⅓	.	⅓	.	2	.	.	⅔	4⅔	1⅓	⅓	.	5	1⅓	1⅔	.	5⅓	⅓	....	.	....	....	.	[illegible]
31 Huntingdon.	.	.	.	.	9⅓	.	.	.	.	.	.	.	21	.	.	.	.	4	....	.	....	....	.	[illegible]
32 Centre,	2⅓	.	⅔	⅓	.	⅓	⅓	.	1⅔	.	2	⅓	4⅓	⅔	5⅔	.	4⅔	8⅔	....	.	....	....	.	[illegible]
34 M'Kean,	⅓	.	.	.	7⅓	.	2	.	⅓	.	2⅔	.	13	.	2⅔	.	.	2⅔	....	.	....	75.57	2	[illegible]
36 Cambria.	.	.	⅓	.	⅔	.	⅔	1⅓	1⅓	⅓	2⅔	1⅓	5⅔	⅔	6	1	6	2	....	.	....	....	.	[illegible]
37 Bedford.	.	.	.	.	⅓	.	4⅔	⅓	2⅓	⅔	6	1	11⅓	1⅓	.	.	.	⅔	....	.	....	....	.	[illegible]
38 Somerset.	⅔	.	⅔	.	⅔	⅔	1⅓	⅔	1⅓	.	4⅔	1⅓	4⅔	1⅓	⅔	.	11⅔	1	....	.	....	....	.	[illegible]
39 Indiana.	.	.	.	.	⅓	.	2	.	.	.	4	.	6⅓	.	5	.	12⅓	.	....	.	....	....	.	[illegible]
41 Warren,	⅔	.	⅓	.	.	.	2⅓	1	⅔	1⅓	8	.	⅔	.	2	.	14	.	....	.	....	....	.	[illegible]
42 Venango,	.	.	⅓	.	.	.	4	.	.	.	.	4	.	.	9	.	.	16⅔	....	.	....	....	.	[illegible]
45 Fayette.	⅔	.	⅔	.	.	.	3	.	2⅓	.	10⅓	.	5⅔	.	4⅓	.	4	.	....	.	....	....	.	[illegible]
47 Washington,	⅔	⅓	3	.	1⅓	.	⅔	.	1	.	3	.	10	⅓	5⅔	.	6	.	73.13	11	....	72.11	13	[illegible]
49 Beaver,	⅓	.	3	.	.	.	1⅓	.	.	.	1	⅓	1	1	13	.	9	⅔	....	.	....	....	.	[illegible]
50 Butler,	.	.	.	.	10⅔	.	1	.	⅔	⅔	1⅓	.	14	.	2⅓	.	.	.	....	.	....	....	.	[illegible]
52 Crawford,	1⅓	.	.	.	.	.	⅓	⅓	8	⅓	4⅓	.	5⅔	⅓	6	.	2⅓	1⅔	....	.	....	....	.	[illegible]
53 Erie.	1	⅓	4⅔	.	⅔	.	⅔	1⅔	3⅔	⅔	2⅓	⅔	5⅓	2	3	.	1⅔	.	....	.	....	....	.	[illegible]

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

FEBRUARY, 1841.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

(Continued from page 11.)

Letter VIII.

New Albany, Indiana, June 15, 1839.

Steam Navigation in the United States.

I have given already, in my second letter, a short extract from a printed document, which was laid before Congress by the Secretary of the Treasury, concerning the steamboats, locomotive and stationary steam engines, in the United States. Since that time, I have, in my travels, obtained possession of many and important data about the extent, importance, and perfection of steam navigation in the last year. The following is an extract therefrom.

1. *History and Extent of Steam Navigation.*

Fulton, a North American, the inventor of steam navigation, constructed, in the year 1807, the first steamboat upon the Hudson river, to make regular trips between New York and Albany. The voyage of one hundred and forty-five miles was then performed in thirty-three hours. The success of this enterprize laid the foundation of steam navigation in the United States.

Up to that time the barks upon the Ohio and Mississippi were propelled partly by sails, partly by oars and poles; from Cincinnati to New Orleans (sixteen hundred miles), such a bark came down in five weeks, and went up in eighty to ninety days; for its management nine men were required down, and twenty-four to thirty-two up stream. In March, 1811, the first steamboat built by Fulton, in Pittsburgh, called the "New Orleans," was launched on the Ohio, and commenced in December of the same year, to make regular trips between Natchez and New Orleans. The time required to make the trip of three hundred miles between the two places was three days down stream, and seven to eight days up. The boat performed in a year only thirteen trips up and down, or seven thousand eight hundred miles. A passenger paid eighteen dollars for a passage down, and twenty-five dollars for one up stream.

Fulton constructed several other steamboats in the United States. He afterwards went to Europe, to bring into execution there, his important invention; but he found no encouragement in England, and when he proposed in Paris the introduction of steam navigation, he was derided by the French, and Napoleon declared him an adventurer. The prejudice of the public, in England and all Europe, against an American invention, which, in fact, was only a new application of steam power, was so great, that five years elapsed, before Bell, in 1812, constructed the first steamboat at Glasgow, in Scotland. Steam navigation now came more and more into practice in Europe, but has as yet not attained such an extent there, as in the United States.

On the 6th of May, 1817, the first steamboat, the "Enterprize," went up the Mississippi and Ohio, from New Orleans to Louisville, and arrived there on the 30th of May, or in twenty-five days. As the barks at that time required nearly three months for the same journey, the inhabitants of Louisville were in such an ecstacy, that they conducted the Captain, Shrive, around in triumph, and gave him a public dinner. The steamboats upon the western and south-western waters now, were constantly increasing in number, and in 1834, they counted already two hundred and thirty-four; in the year 1838, their number rose to four hundred. In 1831, there passed through the Louisville and Portland Canal, in the State of Kentucky, four hundred and six steamboats, and four hundred and twenty-one flat boats, with a tonnage together of 76,323; in the year 1837, passed through the same canal, fifteen hundred and one steamboats, and only one hundred and sixty-five flat boats, with a tonnage together of 242,374.

In the year 1818, the first steamboat was launched on the great north-western Lakes; in 1835, they were navigated by twenty-five

steamboats, and in 1838, the number of steamboats was seventy. In year 1834, eighty-eight new steamboats were built in the United States; in 1837, or three years after, one hundred and thirty-four new steamboats were launched. The largest ship-yards for building steamboats, are at New York, Philadelphia, Baltimore; at Louisville, New Albany, Cincinnati, Pittsburgh, and St. Louis.

In total, there were in the summer of 1838, about eight hundred steamboats in operation in the United States; the greatest number, in any one State, belonging to New York, viz. one hundred and forty.

The travel in steamboats along the sea-shore has, as I observed in my former letters, been mostly superseded by rail roads, located in a more or less parallel direction to the sea coast; and will probably, when the whole rail road system is completed, entirely cease; but the steam navigation upon the navigable rivers is getting more into practice, its increase in the last two or three years, has contributed much to diminish the navigation with sailing vessels or barks; not only all kinds of merchandise without exception, but also provisions, as grain, flour, meat, etc., are carried in steamboats as well up as down stream, and while the freightage is almost the same as upon the barks and sailing vessels, the goods arrive much sooner at the place of their destination if carried in steamboats, and are therefore less liable to be damaged. But still more has been done. Upon the Ohio river, stone coals are now brought by steamboats, two hundred and fifty miles, down to Cincinnati, or rather the flat boats, loaded with coal, are taken in tow and brought down the river by steamboats, and the empty barks taken back in the same way, because the cost of transportation is found to be less in this manner. It is true, the extremely high wages of the boatmen and all other labourers, contribute much to this extraordinary result; but as I shall have occasion to show, hereafter, the crew of a steamboat is also very well paid, and it is to be ascribed entirely to the perfection in the construction of vessels and the engines used in them, and in the application of steam, as also to the improved arrangements in the steamboats generally, that they have produced in America the results, which have been arrived at neither in England nor in any other part of Europe.

The Americans boast of a system of navigable streams in the southern and south-western States not to be met with in any other country of the globe; they maintain that the length of the Mississippi with the Ohio and all other tributary streams, comprises an extent of one hundred thousand miles of waters navigable by steamboats. I would not answer for the correctness of this number, but the Mississippi alone is navigated by steamboats from New Orleans, under the thirtieth degree, to the Falls of St. Anthony under the forty-fifth degree of

north latitude, a distance not less than two thousand miles, and the number of navigable tributary streams of the Mississippi is indeed so large, that a European, who is accustomed to our short travels by steamboats, can only, by being an eye witness, conceive the magnitude of the system of steam navigation in this country. There are daily, at least four or five steamboats starting from New Orleans for Pittsburgh, in the business season, and as many arrive daily, the distance is two thousand miles, or two thirds of that from England to New York across the Atlantic, and nevertheless the voyage is regarded as nothing extraordinary, and is undertaken after a few hours preparation.

2. *Construction of Steamboats and the Engines used therein.*

The steamboats in America, with the steam engines used on the same, are of three entirely different plans of construction. Those upon the eastern waters, comprising the sea along the coast of Boston to Charleston, S. C., and all rivers emptying into the same, have condensing engines, with large upright cylinders, and long strokes, the larger boats draw from five to seven feet water, and go with a speed of from ten to fifteen miles per hour. Upon the Hudson river, the distance from New York to Albany, of one hundred and forty-five miles, is performed in eleven to twelve hours up stream, and in nine to ten hours down stream, including the stoppages at fifteen or twenty landing places, where passengers come on board or leave the boat. I took a passage in the steamboat "North America," on the 23rd of November, 1838, from New York for Albany; as the river was already nearly half frozen over, a great deal of floating ice was coming down; the boat left New York at five o'clock in the evening, and arrived at Albany the following morning at seven o'clock; we made, therefore, including all stoppages, over ten miles per hour up stream. The length of the vessel is two hundred feet, greatest width twenty-six feet; she has two decks, the lower of which, where the engines are, is about three feet above the level of the water; she has two separate cabins; the gentlemen's cabin, which is, at the same time, the dining room, and the ladies' cabin. We were three hundred and twenty passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be. Two steam engines with fifty-two inch cylinders, move the paddle wheels of twenty-two feet in diameter. The pressure of the steam of this, as of most of the steamboats upon the eastern waters is about fifteen pounds per square inch, and the stroke eight to ten feet; the steam is generally cut off at one third or one-half of the stroke, and operates by expansion. For a

voyage of one hundred and forty-five miles, twenty-five to thirty cords (of one hundred and twenty-eight cubic feet), of soft wood are required. The "North America" draws, when loaded, six feet; but there are passenger boats upon other rivers in the east, which draw, when loaded, only twenty-four to thirty inches of water, and move against strong currents.

The steamboats in the west, or upon the "western waters," are, throughout, very flat, and go, when loaded generally five feet deep, some, however, only thirty to thirty-six inches. When the water in a river is only thirty inches deep, the steamboat contains only the engine and fuel, and the cabins for the men, and flat boats loaded with goods are taken in tow. The passenger boats have two decks, the upper one is for the cabin passengers. The elegant boats contain a large, splendidly furnished and ornamented saloon, used as the dining room, and an adjoining saloon for ladies. The saloons are surrounded by small apartments, (state rooms), each of which contains two berths, and round the state rooms is an open gallery, to which a door opens from each state room. Such a vessel offers to an European an imposing and entirely novel aspect. All steamboats upon the western waters have high pressure engines, the pressure of steam being from sixty to one hundred pounds per square inch. Often two engines are used in a boat, and then each engine propels one of the paddle wheels. The cylinders are horizontal, the stroke is eight to ten feet, and the steam is generally cut off at five-eighths of the stroke, and then operates by expansion. The escaping steam is applied to heat the water pumped from the river, before it gets into the boiler.

The third kind of steamboats is to be found upon the lakes in the north and north-west of the Union, they generally go much deeper than the former, are more strongly built, and are propelled partly by condensing, and partly by high pressure steam engines.

3. *Progress of Steam Navigation since its Introduction in the United States.*

The perfection attained in steam navigation may best be estimated after a comparison of the former and present performances of steamboats, and of the former and present rates of charges for transportation of passengers and merchandise.

In the year 1818, a cabin passenger paid for a passage in a steamboat from New Orleans to Louisville, a distance of one thousand four hundred and fifty miles, one hundred and twenty dollars, and for returning, seventy dollars, the passage up, took twenty days, and down, ten days, at present, cabin passengers pay, in the most elegant steam-

boats, fifty dollars for a passage up, and forty dollars for one down stream; while they go up in six, and down in four days. These charges include boarding, which, considering the abundance and choice of the victuals, &c., ought to be estimated at two dollars per passenger per day. The fare is, therefore, now, for the passage alone, taking the average between a trip up and down, (excluding board,) 2.41 cents per mile. Less elegant boats take cabin passengers up, in eight days, for thirty dollars, and for twenty-five dollars down, in five days, which, after deducting one and a half dollars per day for board, gives only 1.22 per mile, at an average between a trip up and down.

Upon the lower deck of these steamboats, which is a few feet above the surface of the water, are the deck passengers, who provide their own meals, and pay for the same passage of one thousand four hundred and fifty miles, only eight dollars; if they assist the crew in carrying wood upon the boat, they pay only five dollars. In the former case, they pay, therefore, per mile, 0.55 cents.

Merchandize was carried, before the introduction of steam navigation, in sailing vessels, which took a load of one hundred and fifty tons; in the year 1817, the charge for freight per pound, from New Orleans to Louisville, was seven to eight cents; in 1819, the *steamboats* commenced carrying freight, and immediately reduced the charge to four cents per pound. At present, the charges per one hundred weight, from New Orleans to Louisville, are according to the quality of the goods, and the season, at least thirty-three cents, and at the most, one and a half dollars; at an average they may be taken at sixty-two and a half cents for the distance of one thousand four hundred and fifty miles. This makes 0.86 cents per ton per mile.

Between Cincinnati and Louisville, the first steamboat, "General Pike," was put in operation in 1819, and made, weekly, a voyage down to Louisville, one hundred and fifty miles, in eighteen hours, and up again to Cincinnati in forty hours. A cabin passenger paid at that time twelve dollars for a passage. At present, the steamboats have so much increased in number, that at least six boats are daily starting from and arriving at Cincinnati or Louisville. Upon the finest boats, as for instance, the "Pike" and "Franklin," the fare is four dollars, and the time occupied in going up, is, including all stoppages, fifteen hours, and in going down only eleven hours; but these boats have frequently made a passage up in twelve, and a passage down the river in seven and one quarter hours; in the latter case, the speed was therefore over twenty miles per hour. If one dollar be deducted for board, there remain three dollars for the passage, which is at the rate of two cents per mile. The deck passengers who assist

in taking in wood, pay only one dollar or two thirds of a cent per mile, and find their own victuals. For merchandize, the charges are fifteen cents per one hundred weight, or two cents per ton per mile.

From Cincinnati to St. Louis, the voyage is five hundred and thirty-eight miles down the Ohio and one hundred and ninety-two miles up the Mississippi river, making together seven hundred and thirty miles. The passage to St. Louis, or from there back, is performed in four days. A cabin passenger pays twelve dollars, of which we ought to deduct at least four dollars and seventy cents for board, this leaves only one cent per mile for the passage alone. The deck passengers pay four dollars without board, which makes nearly one half cent per mile. Goods pay, at an average, fifty cents per one hundred weight, 1.37 cents per ton per mile.

Upon the Hudson river, the passage fare is, in the most elegant boats, three dollars for the distance of one hundred and forty-five miles between New York and Albany, which gives two cents per passenger per mile; for meals an extra charge is made. In less elegant steamboats, passengers are carried the same distance for one dollar, and at this moment even for fifty cents, which gives only one third of a cent per mile.

From the above data we may infer that, at an average, cabin passengers upon the American rivers pay according to the elegance of the steamboats, from two and a half cents down to one cent per mile (board not included), and deck passengers only about one half cent per mile; both travel, taking the average between up and down stream, with a speed of twelve miles per hour. Goods upon the same steamboats are carried, at an average, for one and one third cents per ton per mile.

These striking results, which are attained nowhere else, are chiefly derived from the improvements constantly made in the construction of the boats and their engines. Of the eight hundred steamboats at present navigating the American waters, hardly two will be found of an entirely similar construction; the steam engines, though subject to the same principles of steam power, differ from the English in nearly all their parts. But, three years ago, eight days were required for a trip from New Orleans to Louisville, which is now regularly performed in six. The most remarkable result is, that a boat of four hundred tons required, twenty years ago, for this voyage of one thousand four hundred and fifty miles, three hundred and sixty cords of wood, while at present, for a six days passage, only the same quantity of wood is required.

4. *Rise of Wages, and of the Prices of all Requisites for Steamboats during the last Year.*

What appears most striking, is, that while the charges for transportation have been constantly *reduced* during twenty years, wages and the prices of all commodities *rose* from year to year. The Captain of a steamboat received twenty years ago, a salary of one thousand dollars per year, now he gets upon the better boats, two thousand dollars. Every steamboat has two pilots, who change every four hours; each of them received, in 1822, only sixty dollars a month, but since that time their salary has risen, and was, in 1833, three hundred dollars, which is still now paid to the pilots of the best boats; there are also two engineers upon each steamboat, their salary was, in 1822, only forty dollars per month, and rose in consequence of the great demand for engineers, to one hundred and one hundred and fifty dollars. The firemen and common labourers received, twenty years ago, only fourteen dollars per month, and get now thirty to forty dollars. The whole crew, besides, have free board upon the steamboats.

The provisions necessary for the nourishment of the passengers upon the steamboats, have risen in price during the last five years, thirty-three per cent.

The steamboats upon the western waters use, almost exclusively, wood as fuel for the engines, which, twenty years ago, was quite valueless; in 1834, it sold on the Ohio and Mississippi, for one and three quarters to two dollars per cord, and costs at present two and one quarter to three and one half dollars; the price has therefore increased in the last five years, about fifty per cent.

5. *Cost of Steamboats.*

The steamboats upon the western waters, whose plan of construction might be adopted to great advantage upon our rivers in Europe, are, as I observed already, principally constructed in Louisville, Cincinnati, and Pittsburgh. Generally, the hull of the vessel is built by ship carpenters, the steam engine delivered from a manufactory, and put on the boat, after which the joiners build the cabins and finish the whole. Three different classes of mechanics are therefore required, with whom separate contracts are made; there are, however, individuals who undertake the building and furnishing of a whole steamboat by contract. As the prices differ much according to the solidity and elegance of the vessels, I herewith state the cost of some of the steamboats, which are among the best.

Between Cincinnati and Louisville, the two steamboats, "Pike" and "Franklin," make regular trips, carrying the United States mail;

one of the two goes daily up, the other down, the river. The "Franklin" is one hundred and eighty-three feet in length at her deck, and the extreme width is twenty-five feet, the depth of hold, or the distance from the keel to lower deck, is six and one half feet. The tonnage two hundred ton. Upon the upper deck are forty-two state rooms, each with two berths, making, in all, eighty-four berths; but matrasses are laid upon the floor of the dining room, when required, and one hundred and fifty cabin passengers may sleep upon the boat. The bóat is propelled by two engines, the pressure of steam is eighty pounds per square inch, the diameter of the cylinders, which are in a horizontal position, is twenty-five and one half inches, the stroke seven feet. The steam is cut off at five-eighths of the stroke, and acts through the remaining three-eighths by expansion. The diameter of the paddle wheels is twenty-two feet, their width eleven feet, the dip is twenty-two inches, the paddle wheels generally make twenty-eight revolutions in a minute. The length of the connecting rod is twenty-three feet. There are six boilers of wrought iron on board the boat, each twenty-three feet in length and sixty inches in diameter, each boiler has two flues of fifteen inches diameter.

At an average, the steamboat carries one hundred and twenty-five passengers, one half in the cabins, and the other half on deck, and besides twenty-five tons of goods. With this load she draws six feet water. The boat was constructed in the year 1836, and the cost was:

For the hull, at twenty-five dollars per ton, -	$5,000
" two steam engines, - - -	12,000
" joiners work for cabins, - -	4,000
" draperies, mirrors, bedding, and other furniture in the state rooms, saloons, and kitchen,	9,000
Total, - -	$30,000

This boat is, as observed, one of the most solid and elegant; other steamboats of the same dimensions have cost five thousand to six thousand dollars less.

Amongst the steamboats of the largest class, which run only between New Orleans and Louisville, the "Sultana" and the "Ambassador," are now much favoured by the public; the "Ambassador" has two hundred and fifteen feet length of deck, and thirty-five feet extreme breadth. Her tonnage is four hundred and fifty. On the upper deck are forty-four state rooms, each with two berths, but as many beds may be arranged upon the floors of the saloons. Of the two steam engines, each has a horizontal cylinder of twenty-five inches diameter and eight feet stroke; the steam acts with a pressure of ninety pounds per square inch, and is cut off at five-eighths of the

stroke. The diameter of the paddle wheels is twenty-two feet, their width twelve feet. The boat generally carries two hundred tons of goods up, and three hundred tons down stream, besides one hundred cabin and one hundred and fifty deck passengers; she draws, empty, five feet, and when loaded, seven feet water. The hull of this boat has cost twelve thousand dollars, the engines seventeen thousand, the joiners work, and the whole inner arrangement of this highly elegant structure, amounted to thirty-one thousand dollars, making the cost of the whole boat sixty thousand dollars. It must, however, be observed that great and costly alterations were made during the construction, so that her cost would actually not exceed fifty-five thousand dollars.

Well instructed individuals, who are very much interested in the subject of steam navigation, estimate the average cost of a steamboat upon the eastern waters, at forty-five thousand to fifty thousand dollars, upon the western waters, after a special calculation, at twenty-three thousand five hundred dollars, and upon the lakes, the average between the two, or at thirty-five thousand dollars. Consequently all the steamboats, which were in operation in 1838, have cost as follows, viz.

351	boats upon the eastern waters, at	$47,500	$16,672,500
385	" " western "	23,500	9,047,500
64	" " lakes, "	35,000	2,240,000
800	steamboats, each at an average cost of	$34,950	27,960,000

Now, as since the introduction of steam navigation, thirteen hundred steamboats were built in the United States; the whole capital invested by the Americans in steamboats, amounts to forty-five millions four hundred and thirty-five thousand dollars, the greater portion of which has been expended in the last five years.

To be continued.

Notes of an Experiment with Locomotive Engines. *By* George W. Whistler, Esq., Civ. Eng. W. R. R.

It is the custom to speak and write of Locomotive Engines in reference to their *power* almost exclusively; hence we frequently see in the public prints notice of the performances of engines where the extraordinary results (if they be extraordinary) are set forth to show the superior power of the engine, and accompanied too with remarks calculated, if not intended, to lead the reader to believe that the builder, by some invention or peculiar mode of construction of his own, had

succeeded in producing a greater effect from the same cause than had heretofore been accomplished.

That one engine may be of superior power to another of course is true; just as true as that one house may be of greater capacity than another and for the same reason; because it is built to order on a large plan; but it must be equally true than an engine can have no greater power than is *due to the capacity of its boiler to generate steam*, and that the effect produced by this power can be no greater than is *due to the available weight of the engine for adhesion.* Yet it is sometimes stated that the engines of one maker with less available weight (weight on the driving wheels) than those of any other maker, have superior power and will draw much heavier loads.

To those at all acquainted with the present state of the locomotive engines, and the mode of construction pursued by almost all makers, both in this country and in Europe, to whom the causes for effect are obviously of so definite a nature, and so perfectly limited in every case —being subject to order—such statements and assertions seem strange and unaccountable; it is in fact to say that one pound used as a power will produce a greater effect than another pound, or more distinctly, that the gravity of one pound is greater than the gravity of another pound; and it must be attributed to the apparent inutility of contradicting such absurdities that these statement have been permitted to pass unnoticed. But since it is so apparent that few, if any, will take the trouble to investigate and understand the causes and effects in this machine, but rather treat all questions relating to it as matters of veracity, apparently regardless of the absence of all probability or even possibility of such effects from such causes, I am induced to offer the result of a recent trial on this road of two engines of different makers to ascertain their relative *effective* power.

I am the more induced to do this, because I conceive the growing faith in these oft repeated and undenied statements of superior and *peculiar* power, is not only injurious to the builders themselves, but to the true interests of rail road companies.

It is of serious injury to rail road companies because it induces them, in the expectation of rapid improvements, to limit themselves too closely in their first outfit, and then in the expectation of procuring something of superior and peculiar power, they are induced to go from maker to maker as each may set forth such claims; thus collecting a variety of pattern destructive of that uniformity in the several parts of the engine, which by affording the facility of shifting parts from one to another, or applying parts common to all, is so essential to the economy and despatch of the operations of the road. This variety of pattern and make on any road creates an equal variety of opinion

and prejudice among the agents of the road, for and against engines of different makers, equally prejudical to the maker and the company; when in fact there may not, and among makers of reputation (so far as power is concerned) there is not any other difference than may be the result of the architectural fancy of the builder, sufficient, however, to destroy all uniformity; and I am fully of opinion that this uniformity is of such importance, that all deviations should be avoided until the advantages of a change are of such an obvious nature as to render a total change desirable.

I presume the advantages of this uniformity in the parts of engines cannot be doubted. I have no hesitation in saying (and my experience leads me to it) that a given number of engines with perfect uniformity of parts, permitting the immediate shifting of parts from one to another will perform more, much more, work than the same number equally good in themselves but all differing from each other, and that there are great advantages too in having all the engines on one road of the same make I think will be admitted, when, wherever this is found to be the case on any road, there you find the engines in the best order, and enjoying the best reputation; and whether this be the effect of the prejudices of those who use them, or their faith and natural pride in the good qualities of *their engines* where all are alike, instead of the variety of opinion and equally natural prejudice in favour or against engines of particular makers where all are different; the public is there less incommoded and the company less prejudiced by the delays consequent upon accidents to, or defects in the engines.

Another injurious effect upon rail road companies, and likely to be more serious in its consequences is, that this faith in the superior and *peculiar* power of engines, leads to expectations of almost unlimited effects; at least to such extent that almost any grade could be ascended without the least inconvenience: in short, expectations that could never be realized without some special dispensation of the law of gravity; yet in conformity with these expectations it is frequently urged that roads should be constructed (with reference to cheapness) to conform nearly to the natural surface of the ground, regardless of steep grades, since engines had been *invented*, or certainly soon would be, with power to ascend the steepest as easily as they had heretofore on a level—and engineers are not unfrequently placed in the embarrassing predicament to be overwhelmed with *facts and statements!* in relation to the superior and mysterious effects of engines, depriving them of the immutability of nature's law of gravity to found an argument on.

The Locomotive is a steam engine of the most simple form, and the general plan of construction pursued by almost all makers is essen-

tially (so far as power is concerned) the same. The boilers, the source of power in all, are similar,* being cylindrical, horizontal and tubular: the only difference being that some have square or rectangular furnaces, and others have circular or rounded furnaces; each, however, being able to generate steam sufficient to overcome the adhesion due to the weight of the engine; indeed, this is understood by all good makers to be a necessary condition, and all that I am acquainted with accomplish it.

The reciprocating motion of the piston is applied directly by means of slides and a connecting rod to produce a circular motion of the wheels, either by a crank in the wheel axle, or (which is the same) to a pin in the spoke of the wheel; the effect is precisely the same in both, and if the adhesion between the wheel and the rail be greater than the resistance to progressive motion of the engine and train (from friction and gravity) then will the whole advance; but if it be not, and there be steam power sufficient to overcome what adhesion there may be (and all engines have this power) then will the engine and train remain stationary, while the wheels turn round, slipping, on the rails; and no additional application of steam power can cause it to advance; to say otherwise would be so say, that if I *(having strength sufficient)* should break a lever in attempting to lift a weight, another, *because he has greater strength*, could lift the weight with the same lever!

Yet this is what the public are made in a great measure to believe by the statements we so frequently see of the extraordinary performances of engines. It must be clear then, that the limit to the power of any locomotive engine to propel trains *is the adhesion of its driving wheels to the rails*, which adhesion is at all times, and under all circumstances, *in proportion to the weight on the driving wheels;* and although this adhesion is not the same (in amount) under all circumstances, varying as it is well known, with the condition of the rails, as effected by the state of the weather, &c.; yet it is *always the same with all engines under the same circumstances;* hence the relative effective power of any two engines—power to propel trains—must be strictly *in proportion to the whole weight on the respective driving wheels of each;* which will be seen to correspond with the result of the trial.

I give you the statement as made at the time, officially, to the President of the Corporation, for the information of the Board of Directors.

* This is not strictly correct, vertical tubular boilers are used on engines in Maryland to a considerable extent, and various forms have been adopted in England for the boilers of locomotives on both common and rail roads. Com. Pub.

Engineers' Office, Western Rail Road,
Springfield, August 24th, 1840.

Thomas B. Wales, Esq., President W. R. R. Corporation.

Dear Sir,—In accordance with the leave granted to Mr. Richard Imly, by vote of the Board of Directors of the 11th of April last, to place an engine on this road for trial, he arrived at our depot here on Thursday afternoon with a locomotive engine, constructed by Mr. William Norris, of Philadelphia; the engine is of the largest class: on eight wheels, four being drivers of four feet diameter; her cylinders are twelve and a half inches diameter, and length of stroke twenty inches.

It was arranged that the trial should be made next morning with this engine, to ascertain what load she could draw up the plane on this road, next to our depot here; (it being the maximum grade east of the Connecticut river) and also to see if one of the corporation engines could draw up the same plane an equal load in proportion to the weight on its drivers.

The foot of this plane intersects the level through the depot yard about two hundred feet from the passenger house, and rising at the rate of 60 feet per mile for 8,200 feet, then at the rate of 66 feet per mile for 2000 feet, then at the rate of 46 feet per mile for 700 feet, and thence to the top at the rate of 60 feet per mile, is two and forty-four hundredths miles in length.

The engines being ready with full tenders of wood and water, and steam up, were brought to the platform scales to be weighed; the object being not only to ascertain the whole weight of each engine, but what portion of the whole weight is brought to bear on the driving wheels of each; it is known too, that when the steam is applied to give motion to the engine the effect is to alter the distribution of the weight of the engine between the forward and driving wheels, relieving the former of a portion of their weight and placing it on the latter. Measures were taken in the weighing to ascertain the extent of this change; this was done by placing each engine, first with the forward wheels on the platform scales; the tender, being attached to the engine, was chained to the track to prevent the advance of the engine when the steam was let upon the piston, that the effect might be exhibited by the scales; this effect was to relieve the forward wheels of a part of their weight.

The driving wheels were next placed on the platform, the tender chained to the track as before, and the steam applied; the effect was to increase the weight on the driving wheels.

The results of the weighing are as follows:—

Engine "America," built by Norris.

Weight on driving wheels, - - -	17,550 lbs.
Do. forward wheels, - - -	11,590
Total weight of engine -	29,140 lbs.

Weight of Tender, (eight wheeled) wood and water.

Weight on forward truck, - - -	13,050 lbs.
Do. hind truck, - - - -	12,870
Total weight of tender -	25,920 lbs.

Weighing under Pressure of Steam.

Weight on forward wheels without steam,	11,590 lbs.
Do. do. do. with steam, -	9,650
Difference - - -	1,940
Weight on driving wheels without steam,	18,620
Do. do. do. with steam, -	20,010
Difference - - -	1,390

After this engine had performed her trip, she was placed again on the platform scales, it having been observed that she worked under higher pressure of steam up the plane than when on the platform at the first weighing; at this weighing the result was as follows:—

Weight on the driving wheels without steam,	19,220 lbs.
Do. do. do. do. with steam,	21,070
Difference - - -	1,850

It will be seen that these several weighings differ in their results; this may be attributed, in part, (in the cases where the weights of the same parts of the engine differ when weighed *without* the action of steam) to a different state of the water in the boiler, and to the fact that at the first weighing of the driving wheels the engineer and fireman were both off the foot board; but I am inclined to believe from the very great difference between the first and last weighing, which last was made with great care, that there must have been some error in reading off the first weight.

The difference in the weights under the pressure of steam may be attributed to the different positions of the cranks at the time of weighing, since the effect would vary from a maximum to nothing, depending upon their position.

Taking the weights, however, as they were recorded.

The first weight of the drivers without steam, was	17,550 lbs.
Add weight taken from forward wheels by first weighing with steam, - - - - - - -	1,940
Total weight on drivers in operation by first weighing	19,490
Second Weighing.—On drivers with steam, -	20,010
Third Weighing.—On drivers with steam, -	21,070
	3)60,570
Mean weight on drivers in operation,	20,190

Engine "Suffolk," built at Lowell.

Weight on drivers, - - - - - -	16,150 lbs.
Do. on forward wheels, - - - - -	7,480
Total weight of engine - - -	23,630
Tender (four wheeled) wood and water - -	14,000

Weighing under Pressure of Steam.

Weight on drivers without steam, - - -	16,075 lbs.
Do. do. with steam, - - - -	17,150
Difference, - - - - - -	1,075
Weight on forward wheels without steam, - -	7,480
Do. do. do. with steam, - -	5,700
Difference, - - - - - -	1,780

First Weighing.

Weight on drivers without steam, - - -	16,150 lbs.
And weight taken from forward wheels, - -	1,780
Total weight on drivers in operation, first weighing,	17,930

Second Weighing.

Weight on drivers with steam, - - - -	17,150
	2)35,080
Mean weight on drivers in operation, - - -	17,540

The effective weight (weight on the drivers) of the "America," Norris' engine, is - - - -	20,190 lbs.
That of the "Suffolk," Lowell, is - - - -	17,540

Immediately after the weighing was completed, the "America" was attached to a train, consisting of twenty-seven cars, and started on the level at the foot of the plane within about 400 feet of the plane, commenced ascending with a velocity of about seven miles per hour; ascended about one mile, gradually diminishing the velocity until the adhesion of the drivers being overcome, the wheels slipped and the train stopped, not being able to proceed further up the plane with the load; returned with the train down the plane to the starting station. Mr. Imly was requested to take such load as he thought the engine would take up the plane at a speed not less than six miles per hour; he detached six cars; started again with twenty-one cars, gross weight 259,698 lbs.; with this load she ascended the plane, with steadiness to the top in twenty-six minutes, being at the rate of 5.63 miles per hour.

The engine returned again, with this load, to the starting place, when the "Suffolk" (Lowell) was attached to the same train, leaving off four cars, taking seventeen cars, gross weight 198,042 lbs.; with this load she ascended the plane to the top in 14¾ minutes, being at the rate of 9.92 miles per hour.

It was supposed when this trial was made that the train would give a load to this engine equal to that taken by the "America," in proportion to their effective weights; but it was found, after weighing the cars, that the load was deficient.

The "Suffolk" was again attached to the train with nineteen cars: gross weight 234,218 lbs.; with this load she ascended the plane to its top in 21½ minutes, being at the rate of 6.8 miles per hour.

The whole load of the "America's" train, Tender included, was

Tender	- - - -	25,920 lbs.
21 cars	- - - -	259,698
	Total - -	285,618

That of the "Suffolk's" train, Tender included, was

Tender	- - - -	14,000
19 cars	- - - -	234,218
	Total - -	248,218

Effective weight of the "America,"	20,190
Do. do. do. "Suffolk,"	17,540

Then $\frac{17,540 \times 285,618}{2,190} = 248,129$ lbs., the load the "Suffolk" should have taken; she did take 248,218 lbs., thus showing that the effect produced by each engine, except in speed, was as it should be, *equal.*

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The greater speed of the "Suffolk" is most probably due to the greater diameter of her driving wheels; as the velocity of both trains was such—being small—the difference between them may not have materially effected the resistance.

The engine "Suffolk" is on four wheels, two of which are drivers, four and a half feet diameter. Cylinder twelve inches in diameter and eighteen inches stroke. Pressure of steam in the boiler, ninety pounds. Pressure of steam in the boiler of the "America," one hundred and thirty pounds.

Architecture.

Street Architecture.

Although the means afforded in this description of building for producing architectural effect are greatly circumscribed by the want of room and distant views, yet there are other considerations connected with it which render the subject one of decided importance:—the beautiful suburban villa—the rural and romantic cottage, may, indeed, ennoble and delight the mind of the spectator far more than the most perfect specimen of street architecture; but where *one* sees the villa or the cottage, a *thousand* see the city building; and a thousand minds are in some degree humanized and elevated, however, unconsciously, by its beauties.

Various plans have been resorted to in European cities to improve street architecture by legislative enactments, but with little success. Petersburgh, for example, is all built from designs submitted to, and approved by the government, with the exception of a single street; and that, in 1813, was the only one in the city, (as we are told by Mr. Louden) in which there are varied elevations, and, as the consequence, the only lively and agreeable portion of the town; the rest being a tiresome repetition of similar forms.

The new part of Edinburgh is built on a still more restricted plan —all the street elevations are furnished by one architect, and no builder is permitted to depart a fraction from the prescribed plan without the special sanction of the court; "hence (says the excellent writer just quoted) "it is one of the tamest congregations of buildings in Europe, and were it not for the external views of the old town on one side, and the Frith of Forth on the other, the new town of Edinburgh would be as dull as Berlin." This monotony is, however, counterbalanced by the magnificence of the surrounding scenery, the beautiful situation and grouping of the city, its cleanliness, and the substantial character of its

architecture,—a combination of qualities which render Edinburgh one of the loveliest and most romantic spots in the world.

Other European cities have similar, though modified restrictions on their street architecture, but seldom with a desirable effect;—the perfection of this description of building would be, not to have two elevations alike in any one street; as a repetition of similar forms, beyond what may be required for symmetry, always results in a fatiguing monotony.

The grouping of several houses so as to present the appearance of one extensive establishment, has, when tastefully designed, a better effect than almost any other description of city architecture, and it is certainly to be regretted that so few attempts have yet been made to embellish our streets by adopting a method at once so simple, economical, and effective. This plan has been successfully pursued in European cities to a considerable extent; in London especially it presents some of the most attractive specimens of city architecture ever executed.

An expression of unity may thus be imparted to a row of houses without interfering at all with the idea of their being separate dwellings; all that is required is to advance and elevate the centre and corner houses beyond and above the rest, and to proportion the various parts to the magnitude and importance of the entire group. Such a composition, no matter how poor and plain its individual features may be, will always awaken agreeable emotions of taste;—it looks like a finished work; the spectator realizes that nothing can be added to, nor taken from it, without destroying its oneness; and even though it may be wanting in the higher graces of art, it possesses qualities on which the mind may dwell with pleasure.

T. U. W.

Franklin Institute.

Annual Meeting.

The annual meeting of the Institute was held at their Hall, January 21st, 1841. Thomas Fletcher, Vice President, in the chair; George W. Smith, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Donations were received from The Zoological Society of London; The Society of Arts at London; The Royal Geographical Society of London; Professor M. Faraday, London; Petty Vaughan, Esq., London; Messrs. Marsh, Capen, Lyon, and Webb, of Boston; Thomas Bakewell, of Pittsburgh; Ohio Mechanics' Institute, Cincinnati; Geo.

Merrick, Esq., New Orleans; William A. Burt, Mount Vernon, Michigan; John Stewart, Esq., of Tennessee; James Herron, of Maryland; C. A. Woolsay, President of the Midlothian Coal Company, Virginia; Messrs. Frederick Fraley; M. W. Baldwin, Henry S. Tanner, J. Lyons, John H. Cresson, John Gest, Edwin Bishop, Alfred C. Jones, Isaac Hays, M. D., G. Emerson, M. D.; The American Philosophical Society; The Lehigh Navigation Company; The Legislature of the State of Pennsylvania; Professors Henry D. Rogers, and John F. Frazer, of Philadelphia.

The Actuary laid on the tables the periodicals received in exchange for the Journal.

The annual report of the Board of Managers, accompanied by the reports of the Treasurer and the several Committees, were read, accepted, and referred to the Committee on Publications.

On motion it was

Resolved, That the report of the Board of Managers be referred to a Select Committee of fifteen, who shall, in conjunction with the Committee of the Board, consult and report which measure should be taken to advance the interests of the Institute, and report at a special meeting, to be called by them.

The following gentlemen were named as the Committee.

Joseph Warner,	William B. Fling,
David S. Brown,	Richard Price,
Robert Peirsal,	Thomas Scattergood,
Paul W. Newhall,	Townsend Sharpless,
George M. Justice,	Samuel R. Brick,
John K. Kane,	Thomas S. Stewart,
John P. Wetherill,	Findley Highlands,

Thomas U. Walter.

Mr. Findley Highlands, from the Committee of Tellers of the annual election for officers and managers of the Institute for the ensuing year, (appointed at the preparatory meeting, this day), presented their report of the result of the election; when the Vice President declared the following gentlemen duly elected.

James Ronaldson, President.
Isaiah Lukens, } Vice Presidents.
Thomas Fletcher, }
Isaac B. Garrigues, Recording Secretary.
Alexander Dallas Bache, Corres. Secretary.
Frederick Fraley, Treasurer.

MANAGERS.

Samuel V. Merrick,	Charles B. Trego,
Abraham Miller,	Henry Troth,
John Struthers,	John S. Warner,
Matthias W. Baldwin,	William Hart Carr,
Isaac Hays,	Henry D. Rogers,
J. Henry Bulkley,	John Gilder,
John Agnew,	Ambrose W. Thompson,
John Wiegand,	George Taber,
Samuel Hufty,	Thomas U. Walter,
John C. Cresson,	John H. Towne,
Andrew M. Eastwick,	James Hutchinson,
Isaac P. Morris,	Edwin Greble.

Extract from the minutes.

THOMAS FLETCHER, Vice President.

GEORGE W. SMITH, Recording Secretary, P. T.

Seventeenth Annual Report of the Board of Managers of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts.

The managers of the Franklin Institute present their seventeenth annual report. The year which has just closed has been marked with an unusual degree of activity by our Society, in all the departments of science and the useful arts, to which the attention of the institution is directed by the charter. The particular details of the labours of the several committees of the board of managers, and of the exertions of the professors, have been presented to the Institute in the usual quarterly reports. It may not, however, be uninteresting to the members to make, at this time, a brief summary of the transactions of the year, nor will it, we trust, prove unprofitable to the institution, if we thereby ascertain what is still needed to enable us fully to realize the plans of our original establishment. The great department of the Institute is that of instruction; to the ends of this one all others are subservient, and our usefulness must, in a great degree, be advanced or restricted by the attention to, and success of, our various courses of teaching. So far as the labours of devoted and able instructors will fortify us in this respect, and so far as various and interesting knowledge presented to the classes may have a tendency to promote our success, we may congratulate ourselves in possessing them all. The series of lectures for this winter, embrace complete courses on general chemistry, natural philosophy, and mechanics, application of chemistry to arts and manufactures, geology

and architecture, and in addition to which, we have already had one volunteer lecture on architecture, by a distinguished architect of Baltimore, Robert Cary Long, Esq., in whom the Institute recognize a zealous as well as a highly gifted friend; other gentlemen of ability have likewise promised to lecture on various subjects of interest and utility, by which five evenings in each week will be occupied in our lecture room. It has already been announced that in consequence of the much regretted resignation of Professor John K. Mitchell, a vacancy occurred in our chair of general chemistry, which had been filled by the election of John F. Frazer, Esq. While the distinguished ability of Professor Mitchell made it a difficult task for the Board to select a successor who could advantageously fill the chair which he had vacated, the Board feels that in the talents, zeal, and energy of Professor Frazer, they have met with a gentleman every way worthy to succeed Professor Mitchell, and the general approving voice of the large class of the present session fully confirms the propriety of his selection for the chair. In addition to the regular duties of the chemical chair, Professor Frazer is furnishing the Institute with a full course of lectures on geology, a subject which, in its intimate connections with many important departments of human industry, enjoys, at the present time, a large share of public attention. Professors Cresson and Booth continue in their respective chairs of natural philosophy and mechanics, and of chemistry applied to arts and manufactures, and in the new and valuable illustrations which they are daily presenting to the members, of the discoveries in science, which tend to facilitate various processes in the arts, and to disseminate more correct knowledge of the principles upon which the arts depend. The Institute is steadily progressing under their instructions in forming a body of well trained practical men, fully competent to undertake the construction of the most ponderous machines, or to introduce into our manufactories and work shops, the latest improvements. A course on theoretical and practical architecture has been authorized by the Committee on Instruction, and Thomas U. Walter, Esq. elected to the Professorship in that department. Mr. Walter has just closed his series of lectures for the present season, and the Board feel that in bringing a mind like his, clothed with all the knowledge and experience which places the resources of that art, both ancient and modern, tributary to the illustration of his subject, they have not only contributed to the advancement of the class in a proper appreciation of the beautiful in building, but likewise connected that knowledge with the expressive and high wrought poetry with which the grand but crumbling monuments of skill have been commemorated. The drawing school continues under the charge of Mr. William Mason, assisted

by Mr. S. Rufus Mason, and there are sixty-three pupils in attendance. These pupils have the privilege of attending the lectures of the Institute, and in addition to them, two hundred and sixty-two minors' tickets have been issued, forming a class of three hundred and twenty-five, who are receiving the benefits of our extended courses, at the extremely low price of one cent per lecture. The number of ladies' tickets issued this year have been only sixty-one, which is a subject of regret to the Board, as the influence of their presence and example in the class room cannot but be of great advantage in promoting order and attention.

The very interesting exhibition of American manufactures, held by the Institute in October last, and of which a detailed report has been published, and extensively circulated, fully sustained the character of our country for ability to produce all that has been found necessary for our comfort and ornament. The medals and certificates then awarded have been nearly all delivered, and the value which our manufacturers set upon these tokens of the approbation of our institution, is the best evidence we can furnish of its universally acknowledged usefulness. The suite of rooms in the third story of the hall has been fitted up for the reception of the cabinets of models and of specimens of arts and manufactures, and the access to these collections made easy by a flight of stairs leading from the reading room. Our collection of models, placed under such favourable circumstances, and superintended by a zealous and faithful Committee, is rapidly increasing, and will soon fill the space allotted to it. The cases for the reception of the collection in arts and manufactures, are all prepared, and some valuable specimens have already been deposited. Almost every member of the Institute can readily contribute something from his own work-shop, manufactory, or store, to enlarge the deposits already made, and when the interest and value which such a collection must have in the minds of those who are participating in the benefits of the institution, are taken into view, we feel assured that the donations of our brethren will be liberal. The cabinet of minerals has been regularly arranged by the efficient Committee in charge of it, and already contains a great number of rare and valuable specimens. These are daily augmenting by the donations of our friends in all quarters of the country, and our collection is much frequented by the members, who are gradually acquiring a taste for the beautiful sciences of geology and mineralogy.

The library is receiving gradual additions; it now contains about two thousand five hundred and twenty-two volumes, and during the year, one hundred and fifty-eight volumes have been added, by donations, exchanges for the Journal, and purchase. It has been mat-

ter of regret to the Board that the limited funds of the institution will not permit more liberal appropriations for the purchase of books. The attempt, on the part of the Institute, to establish a Mechanics' Exchange, with fixed hours for the assembling of the mechanics and manufacturers, for the transaction of their regular business, has failed; but it is believed that many of the advantages anticipated from it are realized, in informal meetings which occur throughout the day and evening, in the reading room. The meetings held monthly for conversation on scientific and mechanical subjects, are continued on the same plan as those held last winter, and they continue to be well attended.

Although the Journal of the Institute has met with a considerable share of patronage, the Committee in charge of its publication have found that it was barely defraying the expenses of its editorship and printing. Anxious, however, to secure such a periodical to our country, they have recently made arrangements with several gentlemen of distinguished ability, to furnish contributions regularly for its pages. The talent thus enlisted in its support, and the determination of the Committee to publish it in a larger type, and make it more generally interesting, will, it is hoped, be met by the members of the Institute and the public, by a liberal support of the work. The number of subscribers from among the members of the Institute is quite too small, and it should be a matter of pride with them to place the periodical of their own institution on a ground at least as favourable for its continued publication as seems to be afforded to works of a similar character, coming from the press of our neighbouring cities. The labours of the Committee on Science and Arts, have, as heretofore, been very great. Fifty-nine new inventions, or claims to such, have been presented for their examination, and upon those entitled to favour, as either containing new adaptations of principles or new and valuable combinations, the Scott's legacy medal and premium, or favourable reports have been awarded. During the year, the medal and premium above alluded to, have been deemed due to ten inventors or to ingenious men for improvements, and after making the necessary proofs of originality, they have been awarded and delivered. Under new arrangements made by the Committee on Meteorology, the number of observations on atmospheric phenomena have been increasing.

At present, reports are now received regularly from thirty counties in this State, and also from highly respectable and zealous observers in other States. Regular tables of the mean state of the observations made in our own Commonwealth, are published monthly in the Jour-

nal, and form valuable tables for comparison with those made and recorded elsewhere.

Within the year, the following gentlemen have become Life Members of the Institute.

Messrs. Thomas Mellor, James Christy, Thomas Firth, Isaac S. Ashton, Michael Magee, William H. Moore, Henry J. Biddle, William J. A. Birkey, Owen Jones, William C. Betts, Joseph Woods, Joseph W. Busby, George W. Toland, John Agnew, Lewis Taws, Levi Morris, G. D. Rosengarten, Andrew Young, Thomas D. Lee, William M. Hartshorne, Joseph Hartshorne, M. D., and three hundred and sixty-two new members have been elected.

As nearly as can be ascertained, about fifteen deaths have occurred, and sixty-four have resigned; the actual number of members, both life and annually contributing, may be set down at two thousand. For the state of the funds of the institution, as connected with its general expenditures, publication of the Journal, sinking fund and loans for the hall, and the purchase of the Masonic Hall property, the Board refer to the accompanying reports and statements, from the Treasurer and Committees.

John C. Cresson, *Chairman.*

William Hamilton, *Actuary.*

Philadelphia, January 20th, 1841.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Wm. A. Burt's *Solar Compass.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Solar Compass, invented by Wm. A. Burt, of Mount Vernon, Michigan: Report,

That they have examined the instrument of Mr. Burt, which is a modification of that for which he received the Scott's Medal in 1835. The instrument in its principal parts has been already described. The improvements introduced by its inventor tend to render the instrument more simple in its use, and more permanent in its adjustments. The method is susceptible of any degree of accuracy desired. In the model submitted to the committee, which was the workmanship of Mr. Wm. J. Young, the principle of reversion is applied throughout, and serves to remove all danger of index error in any of its adjustments. In a clear day, in a latitude not yet determined, this instrument, without the use of a telescope, is adequate to the determination of latitude within two minutes, and differences of latitude perhaps to one minute. The line of sight being brought in the direction of an object, and the instrument adjusted for the sun's actual declination,

and the latitude of the place, (determined by a previous culmination of the sun with this instrument,) the exact azimuth from the true north or south is read, and the reading of the compass is of no further use than to serve as a check to the comparative azimuths determined astronomically, and also to furnish a permanent record of the variation of the compass for the particular station. The instrument is simple in its construction and use—requires, when properly understood, no inconvenient expenditure of time—and in districts abounding in magnetic iron ore, is almost indispensable. It seems to be a very important improvement over the ordinary surveyor's compass, and deserving of great commendation. Above all, the committee cannot omit to mention the exceeding value of surveys made with this instrument, in fixing the variation of the compass, and thus furnishing besides the particular result, viz. the boundary and contents of the field or plot, the permanent record also of the magnetic variation. When such results are increased, and the instrument more generally used, which its intrinsic merit fully warrants, a most important addition will be made to the stock of our knowledge on this highly useful element, viz., the magnetic declination and its periodical changes in a great variety of localities.

By order of the Committee.

William Hamilton, *Actuary.*

Philadelphia, Dec. 14, 1840.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1839.

With Remarks and Exemplifications by the Editor.

1. For an improved *Frame Work Knitting Machine;* Richard Walker, Portsmouth, New Hampshire, December 5.

Those who have ever seen a stocking frame must be aware of its great complexity, or rather of the great number of pieces which go to make up the instrument. In the present instance an attempt is made, and we think not without success, to give to the machine greater simplicity without sacrificing any of its good qualities. Although we have had occasion to make a thorough examination of this machine in all its parts, we cannot pretend to describe it in less space than the eight pages occupied in the record of it, accompanied by the different figures in the drawings.

2. For improvements in *Fire Arms;* Benjamin F. Smith, South Hadley, Hampshire county, Massachusetts, December 5.

"The principal feature in which this gun varies from those in com-

mon use, consists in igniting the charge within the cartridge with which the gun is loaded."

The cartridges are formed in the following manner. The outer casing is of paper, formed to suit the caliber of the gun; within this is placed the proper quantity of powder, and next to the powder is placed the torpedo, or wad, into the centre of the lower end of which is inserted a small quantity of percussion powder, which ignites by being pierced with the point of a needle. This needle is to be forced in by the action of the lock, through the centre of the charge of powder, and into the wad in front of it containing the percussion powder, and the discharge is to be thus made.

The whole instrument is described with considerable minuteness, and the patentee says, "I do not claim separately the needle for igniting the charge, or the spur for holding the cartridge, but I do claim the combination of the needle and tumbler, and the combination of the spur, horizontal lever and tumbler as described; and the peculiar construction of the hand lever by which it operates upon the tumbler and spring, and the horizontal lever at the same time, for the purpose of removing the needle and spur, so as to admit the cartridge and cocking the gun at the same operation."

We are aware that the foregoing claim will not explain the particular construction of the parts; but we think that enough has been said to lead to the conclusion that however ingeniously the parts may have been contrived, there is but little probability of this gun being brought into general use.

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3. For improvements in *Railway Bars;* Edward Tilghman, Civil Engineer, city of Philadelphia, December 5.

"The nature of my improvement is in the so forming the bar that there shall be a reduction of the height usually given to the T rail, between its head, and the base on which it rests, thereby diminishing the leverage of the rail, whilst its strength and its capability of being firmly secured to the cross tie are provided for by the addition of a rib directly under the centre of the base, which may be made plain, trapezoidical, or with a lower web, as practiced in many English edge rails. To fasten this rail I insert the lower rib thereof in gains cut in the cross ties, at the lower part of which gains there is a suitable recess for one side of the lower web; the rail is to be inserted in this gain and wedged securely in its place, where it will be supported conjointly upon the ordinary base, and upon the under part of the lower web."

The claim is to "the addition of the under rib to the T rail, below its base, or seat, in the manner and for the purpose set forth. I do not claim the inserting the lower part of the rail within the thickness of the cross tie, this having been before done, but I do claim the employment of a chair inserted and used in the manner set forth, for the purpose of joining and firmly securing the ends of the railway bars."

The chair referred to consists of a flat plate which is received into two notches, one in the end of each bar, immediately under its base;

the two when put together constituting a mortise that receives said chair, or plate, which is affixed to the cross-ties by bolts or spikes.

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4. For a machine for *Separating Corroded and Uncorroded Lead;* Edward Clark, Saugerties, Ulster county, New York, December 5.

The semi-corroded lead is to be passed between rollers, furnished with grooves, or checkered, so that the uncorroded lead will be stretched, or bended, and again straightened, and thus the corroded parts be separated from that which remains metallic.

The machine is to be put in motion so that each individual roller will turn inward upon its fellow, and downward; and the lead is to pass through between these rollers in a crimped state to the next series, and so on, when it falls upon an endless apron, and is carried away to be again subjected to the corroding process. The claim is to the combination of plain and grooved rollers, and also the revolving apron, brushes, and scrapers, &c.

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5. For a *Spark Arrester;* Nicholas Turbutt, Fredericktown, Frederick county, Maryland, December 7.

Not finding in this instrument any thing which appears likely to overcome the difficulties which have condemned to banishment, most of the members of the family of spark arresters, we shall not take the trouble to describe it, nor will it be of any use to insert the claim.

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6. For a *Cotton Press;* John Price, Nashville, Davidson county, Tennessee, December 7.

The claim made by the patentee is to "the manner in which I have combined the power of the screw, and the levers. That is to say, I claim the first pressing by means of the screw, and then securing the upper follower by means of the compression blocks, and the completing of the operation of pressing by the two leavers acting upon the lower follower, in the manner described, said levers being drawn down by any adequate power; I claim the particular combination of the swivel and its appendages, for raising the lever."

The pressing screw is placed vertically, and descends by turning a lever, or cross head, as in many other presses for cotton. When this screw has compressed the cotton to the extent of its capacity, a follower beneath the cotton bale, is forced up by means of two levers which have their fulcra in the cheeks of the press, their short arms under the follower, and their long ends extending upwards at an angle say of 40° on each side; these by being drawn down force the lower follower up, and give additional pressure to the bale.

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7. For a *Franklin Cooking Stove;* Abner R. King, Parma, Monroe county, New York, December 12.

"The nature of my improvement consists in a new and useful combination of a swinging damper in the back plate of a common Franklin stove." The manner in which the patentee carries out his design of adding a cooking apparatus to the back part of, or behind, the ordi-

nary Franklin stove, occupies several pages in description, referring to ten figures in the drawing. The claim is made by letters of reference to the respective parts, and need not be given. To us the arrangement appears to be such as will afford little advantage in cooking, whilst the stove itself will be an inconvenient article. The idea of combining an open Franklin with a cooking stove is not new, it has been often attempted, but has never gone into extensive use.

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8. For a *Fracture Apparatus;* Horson M. Allaben, Middletown, Delaware county, New York, December 12.

The claim is to "the combination of the splint, foot-board, and extension roller, with the fracture bed, or chair." This apparatus consists of a bed, or couch, on which the patient is to lie, and which is furnished with the devices rendered necessary, or convenient, by his position and state; to this is also appended the apparatus required for cradling, and giving extension to, a fractured limb. The description occupies ten large pages, which we shall not attempt to epitomize. Such an instrument, if it offers any advantages, we always think ought to be given to the public, especially if they are devised by those in the practice of the healing art. Perhaps we are wrong in this conclusion, and we are willing to be thought so to be.

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9. For an improvement on *Bedsteads;* Benijah Bosworth, Fayette county, Kentucky, December 14.

This patent is for the mode of fastening the posts and rails together, and of tightening the sacking bottom. The rails are to be round, and have round tenons on their ends; the sacking bottom is to be attached to them by wooden pins and eyelet holes; and on the part which will become the under part of each rail there are to be projecting pins inserted, three or four inches from each end, making in all eight such pins, an inch in diameter and two in length, with a neck turned near their outer end. Round these pins cords are to pass like those used for tightening a frame saw, and the cords are to be twisted by means of a stick of wood, in the same manner, and thus the sacking is to be tightened.

The claim is to "the method herein described of tightening the sacking bottoms of bedsteads by means of the rope attached to the pins projecting from the under sides of the rails, and twisted by a stick."

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10. For a *Visceral Supporter;* Benjamin Reynolds, Camden, South Carolina, December 14.

The patentee calls this the *Gerenteron, or Visceral Supporter*, and has given a description, and dissertation extending through fifteen pages of record. His claims are the following.

"1st. Constructing the back pad plate a little raised on each side of the centre so as to form a recess on the under side that the spine may be safely lodged therein, in combination with the vertical hinge in the centre, permitting each side to fold down so as readily to adapt itself on each side of the spine, to any shape of the back.

"2nd. The combination of the hip springs, constructed and arranged as described, with the front and back pad, the whole being arranged and operating in the manner set forth.

"3rd. The mode of adjusting the hip springs on the front pads, as described.

"4th. The mode of adjusting the front pads so as to adapt them to any sized abdomen.

"5th. The construction of the pad for supporting the perineum with an elliptic spring in the centre, as described."

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11. For *Bedstead and other frame work fastenings;* Joseph Rodefer, Cincinnati, Ohio, December 18.

The claim will afford a general idea of the bedstead fastening referred to, and which is called an *improvement.*

"I not claim to be the inventor of the mode of fastening the rails of bedsteads into the posts by means of a bolt with the segment of a screw on its end projecting from the former, and secured into a mortise in the latter, this having, as I am informed, been previously patented. But what I do claim is the mode herein described, that is to say, having the segment of the screw on the end of one rail embrace a screw on a projection from the end of the screw bolt attached to the adjoining rail, as herein described."

New modes of fastening bedsteads are frequently brought forward, and those who devise them no doubt attach great importance to them; they hope, at least, that others will be induced to do so. After examining through the whole catalogue of fastenings we have not met with one which we would prefer to the old fashioned bedstead screw, when well made, so as to fit the nuts indiscriminately. When the saving of twenty-five cents in a set of eight screws is made an object, they will be inferior in quality, with bad threads, and irregular in size, and this is the main source of objection to them; but if we wanted bedsteads we would take care to have them furnished with good screws and nuts of the common kind.

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12. For an improved *Silk Loom;* Cornelius Bergen, city of Brooklyn, New York, December 18.

Although the loom as improved does not vary, in general, from others, the description of it is given at much length in the specification, which concludes with the following claims. "1st. The employment of the cams with double sections in connection with the arrangement of levers and springs for the purpose of driving the shuttles, as described. 2nd. The making of the batten is two parts for two or more rows or tiers of shuttles, and, in combination therewith, the manner of throwing the shuttles by means of three drivers, one acting as the main driver, by the action of which the other two are driven, as described. 3rd. The arrangement of levers, springs, and cams, for raising and lowering the shuttles, in combination with the batten; the cams to be dispensed with when working by hand, as described."

13. For a *Cheese Press;* William W. Townsend, Shoreham, Vermont, December 18.

The claim is to "the method of applying the weight to the press, by having a cord and a loop, ring, or something equivalent thereto, attached to the weight; the former for the purpose of winding up a weight by passing over a pulley, or pulleys, and the latter to attach the weight to the lever; the whole being constructed substantially as set forth;" which construction consists in the particular manner in which the parts are arranged, which possesses so little of the attribute of invention as to render it difficult to find for what the patent was granted, and, therefore, very easy to avoid interferance without evading or invading any vested right.

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14. For a *Burner for Burning Pine Knots;* John Price, Nashville, Tennessee, December 18.

This burner is made much like the common old fashioned iron candlestick, but large, so as to hold a pine knot: and it is pierced with holes below the holding part, to give the requisite current of air. A funnel is to be placed over it, to carry off the smoke.

The claim is to "the use of a vertical tube, or other suitably formed body, perforated with holes for the admission of air to the burning pine knot, light wood, or other analogous material, which is to be placed therein, as herein set forth, and the burner set under a funnel and smoke pipe, or other analogous fixture."

A contrivance for burning pine knots, or light wood, may appear to be a trifling affair to those who live in the region of oil, tallow, and spermaceti; but the millions, whose only artificial light is "*light* wood," in the west, and in the south, may think otherwise, and although there is no great display of mechanical talent in the device referred to, it may make up in utility what it lacks in invention, and furnish a convenient mode of effecting that which is now effected in a very rude and inconvenient way.

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15. For a *Spring Bolt Shutter Fastening;* George Smith, city of Philadelphia, December 18.

The whole specification of this patent is contained in a small compass, and is as follows:

"The nature of my invention consists in attaching to the plate on which the bolt is stapled, a guard or lock for a key, which operates on a spring similar to a spring lock. The spring is set on the under side of the bolt plate, with a catch fixed to the spring; when the bolt is shoved home, the catch springs up into a corresponding notch cut in the bolt, so that it cannot be unbolted without a key to press the spring catch out of the notch in the bolt. The bolt in other respects has the usual plate and staples. The above particulars will enable any one skilled in the art, to make and use my invention.—What I claim as my invention, and desire to secure by letters patent, is the employment of the spring catch opened by a key, acting on its sloped face,

and attached to the back of the bolt plate, in combination with the bolt, herein described."

We apprehend that the necessity for using a key for a shutter fastening will be a fatal objection to its general adoption, whatever might be its merits on other points.

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16. For a *Smut Machine;* Samuel W. Foster, Scio, Washtenaw county, Michigan, December 21.

"The nature of my invention consists in constructing a floor of the cylinder with a rim or coller, around the shaft, for the purpose of preventing the grain from passing out between the shaft and cylinder; and in combination therewith, adapting a disk to the aforesaid rim, or collar, by countersinking it, by which means a trough or channel is formed for the grain, in which it is retained and operated upon with more effect than if the bottom of the cylinder were a perfect plane."

The grain is to be fed in on the upper side of a vertical cylinder, against the rough and preforated sides of which it is thrown by revolving arms, and beneath them it is rubbed between projecting points on the bottom of the cylinder and revolving rubbers. The difference between this and some other smut machines is small, and the claims are limited to certain minor arrangements, the principal of which are designated in the above extract stating the nature of the invention.

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17. For *Manufacturing Needles;* Abel Morrall, Great Britain, December 21.

"My improvement in making or manufacturing needles, consists in an improved mode of clearing and finishing the eyes of sewing needles, by removing any burs, feathers, or sharp edges, from the insides of the eyes, of such needles, which, without being so cleared and finished would be subject to cut the thread in the operation of sewing." "The invention consists in the spitting or stringing of needles upon a steel or other wire, or any suitable substance which may be passed through the eyes thereof, and which either by means of edges or teeth formed thereon, or by the application of some grinding or polishing material thereto, shall remove the asperities from said eyes and render them perfectly smooth, by giving to said needles, while so strung, a shaking or reciprocating motion, as set forth."

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18. For a *Self Acting Safety Valve;* John P. Bakewell, city of Pittsburgh, Pennsylvania, December 21.

"The nature of my invention consists in a mode or method of fastening and securing the standard, or upright, which is connected with the fulcrum, pivot, or turning point, of the beam, or lever, of a common safety valve, in such a manner as that the heavier the weight may be which is placed upon the opposite, or long arm of the beam, for the purpose of keeping the valve closed, the more certain and effectual shall be the operation of the apparatus in opening the valve whenever the boiler, or generators, shall have been heated to such a degree of temperature as may be considered dangerous, or liable to become so."

A fusible metallic alloy is to be used in this apparatus, by the melting of which at a given temperature it is intended to insure the operation of the apparatus; the use of this metallic alloy is not claimed, "or the combination of a vertical cord, or stem, therewith,—or their further combination with the lever or beam of the safety valve, as these are not new, and are claimed by Mr. Oliver Evans, as his invention." But the patentee claims "the mode in which he has arranged the several parts of the apparatus; that is to say, the attachment or connexion of a rod, or stem, to the end of the lever or beam of a safety valve, in such a way as that it shall be the fulcrum, pivot, or turning point of the beam as long as the alloy remains unfused. And the placing a standard or upright between the safety valve and the weighted end of the lever, to which the beam shall shift its fulcrum or pivot whenever the alloy shall become fused, or melted."

There is, it seems, considerable resemblance between the foregoing plan and that patented by Mr. Evans, but the two were considered in the office as sufficiently different to justify the grant of a patent in the present case; whether this question has been made one of legal investigation we are not informed, and prefer not in the present state of the question, to express any opinion of our own, without being authoritatively called upon so to do.

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19. For constructing *Portable Houses for Transportation;* Frederick S. Barnard, city of Philadelphia, December 21.

The point claimed is "the completing the sides, ends, floors, roofs, &c., separately, and completely finished, to be put together, as described."

The particular manner of connecting the parts as given by the patentee need not be detailed; and we suppose that any good carpenter would find it easy to put his work together in modes of his own devising, without interfering with any vested right, if such there are which can be sustained. We are apprehensive also that it will rarely be found convenient to transport the parts of houses in such large masses as would be required on the proposed plan.

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20. For an improved *Wheel for Carriages;* Elisha Talles, city of Hartford, Connecticut, December 27.

The wheel is denominated a *Metallic Suspension Wheel;* and after describing it, the patentee says that he does "not claim the suspension principle, or the making any part of it of metal; or any thing in the shape of the spokes, or the securing them at each end by nuts; but I do claim as my invention and improvement, 1st. The rim of the wheel of the form and shape hereinbefore described. 2nd. The furnishing a metallic hub with a box, or boxing, which can be replaced when worn, and secured in its place, as described. 3rd. The sand valves in the manner and for the purpose described."

The rim of the wheel is so formed as to have a groove, or channel, around it, which is to receive wooden felloes, and these are to be sesured in their place by hoop tire, in the usual way. The hub is cast

with a perforation large enough to receive a metallic box, or boxes, for the axle to run in. The "sand valves" are washers, with rims, borne up by springs against each end of the hub, to prevent the entrance of dirt of any kind, and to keep in the oil.

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21. For *Dressing Paper Pulp;* Nathaniel Hebard, Dorchester, Norfolk county, Massachusetts, December 27.

The ordinary pulp dresser, consists of a plate of metal having numerous narrow slots cut along it, for straining the pulp. In cleansing these out when they become choaked, the openings are gradually widened, and the instrument injured. The object of this invention is so to construct this instrument as that the openings may be narrowed and widened at pleasure, and set to any degree of fineness. For this purpose, strips of metal, of equal widths, are attached to a frame by joint pins at one of their ends, and at the other by similar joint pins, to a sliding bar. When the strips stand at a right angle with the part of the frame to which they are jointed, they are at sufficient distance apart to clear them from all obstructing matter, and by means of the sliding bar to which they are jointed at the opposite end, they may be made to approach each other in any required degree. The claim is to this arrangement of the parts.

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22. For an improved *Rail Road Chair;* Britton M. Evans, city of Lancaster, Pennsylvania, December 27.

This chair is intended to obviate the necessity of wedging the Wigan rail. The chair is to be cast in two parts, one of its sides, or cheeks, being separate from the other, and being removed to put in the rail; when so placed, the loose cheek is driven in, and the rail thereby confined; the patentee says, "I would have it understood that I am aware that rail road chairs have been made with a movable jaw, and secured by means of wedges; I do not, therefore, claim that as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the making of the movable jaw with a dovetail to fit into a corresponding slide in the chair, and secured by a pin, as described."

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23. For a *Socket for holding Tools;* Herrick Aikin, Franklin, Merrimack county, New Hampshire, December 27.

This socket varies but little from others that have been made for holding awls and other tools, and is in itself a subject of so little importance, excepting to the patentee, as not to require a particular description.

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24. For a *Cooking Stove;* George D. Boyce, West Wareham, Plymouth county, Massachusetts, December 27.

This stove is in the ordinary form of those having a fire chamber in front, with an oven in its rear, and boiler holes at top. The claim, therefore, is confined to certain special arrangements; such as to the

manner of arranging the flues and dampers; the dividing the fire chamber into two parts, so that the fire space may be limited when required; and to the manner of combining a pipe for carrying off the vapours, with a sliding smoke pipe.

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25. For a *Truss for a Bridge;* Herman Haupt, York, York county, Pennsylvania, December 27.

"The distinguishing feature of the proposed improvement, is that no counterbraces are used, and the ties are in both straight and curved bridges, perpendicular to the lower chord, the pieces being of the size and arrangement similar to that which is usual for lattice braces."

"What I claim as my invention is the construction of a lattice bridge without counter braces, but consisting simply of braces inclined at any proper angle, and ties which are perpendicular to the lower chord, the chords being either straight or curved."

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26. For an improvement in *Bee Hives;* William M. Hall, Wallingford, New Haven county, Connecticut, December 27.

The object of this invention is so to construct the hive as that it will discharge the worms and other filth that may infect it. To effect this, a double inclined plane is placed at the bottom of this hive, by means of which the discharge is to take place. There is to be an opening of about half an inch at the junction of these planes, through which the bees may enter, and the foreign matters will fall. The claim is to "the protecting base, made with inclined planes, substantially in the manner and for the purposes specified."

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27. For an improved *Spark Arrester;* Thomas Raeney, city of Philadelphia, December 28.

This spark arrester operates upon the same principle with that of Mr. Briscoe, the specification of which was published in vol. xxiv. p. 236, of the last series; but the improvement consists in greatly enlarging the space allowed for the escape of the draught, through inverted cones of wire gauze, or of perforated metal inserted in a cap plate forming the top of the chimney. Mr. Briscoe used but one inverted cone of this kind. The patentee says, that "in an apparatus of this kind I have used eight such perforated cones; the center cone at its upper or open end is eleven inches in diameter, and twenty-one inches deep to its angular point or apex, with seven surrounding cones, eight inches in diameter at their open ends, and thirteen to their angular points."

"I am aware that the top or covering of a cap, or hood, has been made of wire gauze, in the form of a single inverted cone or curved segment of a hollow sphere; but it is not possible with a single cone to obtain sufficient escape surface for the draft. I do not, therefore, claim the merely giving to the covering of such a cap the form of an inverted cone; but what I do claim, is the inserting of a number of such cones of perforated metal or wire gauze into suitable openings in the plate of metal which forms the covering, or top, of such a hood

or cap, for the purpose of giving sufficient surface for the passage of the draft through the perforations or meshes of such cones. I also claim, in combination with a number of cones arranged and perforated as described, the perforating of the upper sides of the hood, or cap, said perforations being surrounded by a rim retiring from said hood, or cap, and rising up above the upper surface of the top plate thereof, as set forth."

We have repeatedly heard favourable reports of the operation of this instrument, which has continued in use, and that is more than can be said of a number of others.

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28. For a *Blowing Apparatus for Furnaces, &c.;* Frederick R. Dimpfel, city of New York, December 28.

The blowing wheel in this apparatus resembles that in ordinary use, but "between the wind wheel and the outer case, a space is left which may be denominated the air chamber. In this space, as also in and around the wind wheel generally, the air will become condensed by the rapid motion of the wheel, and not being able to escape in consequence of the closure between the collar and the outer case, as described, it may be made to exert a pressure of several pounds to the square inch, by regulating the escape opening."

The claims are to "the enclosing of the vanes of the wind wheel with circular sides or rims, between which and the outer case there is a space left, as described; and the attaching a collar to said sides or rims, to admit air to the revolving vanes, said collars being made to run air tight, to prevent the escape of air from the air chamber. The whole being constructed and arranged in the manner set forth."

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29. For an improvement in *Umbrellas and Parasols;* Elisha Hale, Newburg, Orange county, New York, December 28.

This umbrella is constructed so that it can be folded, and slid together in such a manner as that it shall not occupy more than half the length required for those made in the ordinary way.

The claim is to "the forming of the staff of an umbrella or parasol, of two tubes, or of one tube and one solid piece of nearly equal lengths, having springs and catches on them, and sliding one into the other for the purpose of shortening them in the manner of telescope tubes, and in combination therewith, the forming the metallic or other spreaders of an umbrella or parasol, with a division in them, and united by clasps having springs and catches on them, and sliding one on the other to reduce them to nearly one half their extended length, in manner set forth."

There is in the possession of a member of our family, an umbrella which has seen at least forty years service, which possesses all the attributes of that above described; and this is not the only one of the kind that we have seen. So far as the sliding tubes are concerned, we have seen many of such umbrellas and parasols constructed for traveling; but the one first spoken of has the joints in the spreaders, and was, we suppose, made under an English patent. The present

patentee, is, no doubt, the inventor of what he describes and claims, but he has the misfortune of not being the *first inventor*, by a period of about half a century.

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30. For a *Sifter of Coal and Ashes;* Horace Welles, Hartford, Hartford county, Connecticut, December 31.

This apparatus consists of a box of sheet metal somewhat deeper and higher than the ash drawer of the stove, the coal and ashes from which are to be sifted. There is an opening in the metallic case fitted for receiving the drawer with its contents, and when in place, the sifter is to be inverted, and upon shaking it, the ashes will pass through a riddle, formed by a perforated plate, or by bars, fixed in the box, so as to cover the top of the drawer. After this shaking, the box is to be turned on its back end, to allow the ashes to pass into a space behind the drawer, which space, from the length given to the box, forms a suitable receptacle for them. The case is next to be turned on its bottom, and the drawer containing the coals, withdrawn, when the ashes may be thrown out by turning the box on its front. The claim is to the combination of the respective parts, as above described. We do not wish to purchase one of these sifters, it has too many conveniences about it.

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31. For a *Tape, or Chalk Line Winder;* Gerard Sickles, Middletown, Middlesex county, Connecticut, December 31.

This winder consists of a cylindrical bobbin, upon which the tape, or line, is to be wound, and which, we suppose, is to be made of tin plate, or other sheet metal. It is inserted within a cylindrical case, through which there is a slat, or hole, for the passage of the tape, or line. The inner cylinder, or bobbin, is hollow, and to this the inner end of the tape, or line, is attached. A ring, into which to pass the end of the finger, serves to give a revolving motion to the bobbin, when the line is to be wound on to it. The claim is to "the mode described, of constructing a reel without a shaft, revolving within a case."

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32. For a *Railway Safety Brake;* George S. Griggs, Roxbury, Norfolk county, Massachusetts, December 31.

(We have cuts of this apparatus, and will give the specification, with some testimonials of its action.)

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33. For a *Substitute for Oil for burning in Lamps;* Isaiah Jennings, city of New York, December 31.

(See specification.)

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34. For a *Hat Colouring Machine;* George M. Johnson, Port Deposit, Cecil county, Maryland, December 31.

This machine very much resembles some of those used for dipping candles, which machines have arms extending out from a vertical shaft, which arms carry the candles to be dipped over the kettles containing

the tallow. Substitute hats for candles, and let the arms have on their ends boards furnished with suitable pegs, by which to confine the hats in place, that are to be dipped into the kettle, and you have the present machine; the arms vibrate and allow of the articles upon them being lowered into the kettles. The object is to immerse into the kettle, and to raise from it a suit of hats, and to swing them round out of the reach of the steam, thus giving them a perfect chance to become cool. The claim is to "the method of putting the suits in and out of the kettle, and swinging the suits round so as to let them cool whilst other suits are colouring, as described."

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35. For an improvement in *Tanning;* Lewis R. Palmer, Maryland, Otsego county, New York, December 31.

This improvement consists of "a machine for changing the hides from one vat to another, and expressing the exhausting liquor therefrom. The nature of the invention consists in a certain new and useful arrangement of loose rollers on an horizontal axle, placed above and parallel with a revolving cylinder, between which the hides are pressed, and by which the exhausted liquors are expressed therefrom, however uneven the surfaces of the hides may be, which cannot be effected by parallel cylinders of equal length."

The claim is to "the before described combination and arrangement of the parallel, loose, revolving rollers with the revolving cylinder placed below the same, between which the hides are drawn for pressing the exhausted liquors therefrom, in the process of tanning leather.

The loose rollers are cylindrical rings arranged side by side on the upper horizontal shaft, the perforations in their centres being of such size as to allow them to play upon the shaft, and to bear, by their separate weights, upon the hide beneath them.

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36. For an improved *Kitchen Range;* Ebenezer Barrows, Mattapoisett, Plymouth county, Massachusetts, December 31.

We cannot, without devoting too much space to the subject, attempt to describe the peculiarities of this range; we know, however, that it has afforded full satisfaction to numbers who have used it in the city of Boston, where it has been extensively introduced.

The claim is to the peculiar arrangement of the valves and flues, with other devices set forth in the specification.

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37. For an improvement in *Constructing Circular Saws;* Menassah Andrews, Bridgewater, and James Sproat, Taunton, Massachusetts, December 31.

The object of this improvement is "to relieve the collar of a circular saw used for the purpose of sawing boards, shingles, and other articles, from the friction occasioned by the pressure of the article sawed, as it is separated from the block upon the collar of the saw." To effect this, a stationary curved plate is fixed to the frame of the machine, at the back of the saw, against which plate the stuff sawed is to bear,

as it is curved off from the saw, instead of bearing against the collar. The edge of this plate, nearest to the edge of the saw, is received behind a shoulder, or offset in the collar, thus insuring the end of the piece sawed, a passage on to the face of the plate.

The claim is to "the countersink in the collar, as described, and the insertion of the stationary plate, or reliever, as described, in such manner as to receive upon its edge the article sawed, as it is separated from the block."

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38. For *Cutting Seats, Slats, or Grooves, in Hubs, &c.;* Thomas J. Butler, Johnstown, Cambria county, Pennsylvania, December 31.

By turning to vol. xix. p. 30, of the last series, a specification of an apparatus for the same purpose with that above named, will be found, as granted to Francis Barker, of Baltimore; not only the purpose, but the means of accomplishing it, are substantially the same in the two plans. The date of Mr. Barker's patent is not mentioned, as it was probably among those granted a little time previously to the burning of the office. The specification of Mr. Butler's patent was prepared by the editor, who, at the time of writing it, was fully impressed with the conviction that the apparatus had been already patented; but it was not to be found in the office, and from the want of a date, and place on the list, it was overlooked both by the editor, and in the patent office; a kind of accident which is not of frequent occurrence.

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39. For *Propelling Steamboats;* Benjamin D. Beecher, Prospect, New Haven county, Connecticut, December 31.

The mode of propelling described by the patentee, is intended, principally, for canal boats. "The invention consists in constructing the bow, or fore part of the boat, so as to accommodate the screw or other propellers which I place there, which are intended, by their particular position, and mode of action, to draw the water directly from the bow, and to give it, as it passes towards the stern, such a direction as shall greatly diminish the resistance offered to the passage of the boat." The propelling is to be, in general, effected by means of two spiral or screw wheels, placed immediately in front, so as to extend completely out to the cutwater; and the claim is to "the manner of locating the two propellers in the bows of the boat, in combination with the manner in which I construct and extend the bottom of the boat forward, and thus causing the propellers to act upon the water in a direction inclined from each other, in the manner, and for the purpose, set forth."

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40. For preserving the *Equilibrium of Steamboats;* Samuel M. Purse, and Martin Staley, Ashley, Pike county, Missouri, December 31.

The claim shows pretty clearly the nature of this invention, and is in the following words. "What we claim as our invention, and

desire to secure by letters patent, is the preserving the equilibrium or trim of steamboats, by means of an apparatus operating substantially in the manner of that herein described; that is to say, the combination of a pendulous weight, clutch, gearing, and weighted carriage, or suspended weights, as set forth, for the purpose of preserving the trim of boats, and thus improving their speed, and obviating a frequent cause of explosions."

A shaft is sustained on the deck of the vessel in the direction of its length; and from this is suspended a pendulous weight, by the swaying of which, from side to side, the shaft will be turned partially around. This shaft is geared into a rack on the bottom of a loaded truck, placed on ways across the deck, which will be moved in a direction opposite to that towards which the pendulum swings. The shaft may also be geared to a crane carrying a suspended weight, which will consequently be swung from side to side, as required.

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41. For an improvement in *Fire Arms;* Silas Day, and Samuel Hall, city of New York, December 31.

The claim under this patent is to "the method of retaining the extra breech in its place in the barrel, by means of the projection on the extra breech, to which is attached the nipple, fitting into a corresponding recess in the breech plate of the barrel; but we do not claim as our invention the entire extra, or movable breech, which contains the charge." We do not think it necessary to give further particulars, at present, and doubt whether they will ever be called for.

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42. For an improved *Wool Carding Machine;* Nathan Freeman, city of Lowell, Massachusetts, December 31.

This improvement consists, mainly, in dispensing with the upper feeding roller, and placing in its stead, and between the remaining feeding roller and the main cylinder, a bar, so formed as to be nearly in contact with the carding cylinder, and allowing room between it and the feed roller for the passage of the wool, which space diminishes from the point at which the wool enters, to the point of its delivery on to the carding cylinder, which is in a line with the axis of the cylinder and roller. The apparatus is very clearly described; and in its use it is said that "the wool being conveyed and supplied to the feeding roller by means of an endless apron, or drawings, or bats, or in any other convenient way, is carried towards the end of the lip of the bar, and while pressed between it and the feeding roller, and passing the end or edge of the lip is operated upon by the teeth of the main cylinder, tumbler, or carding cylinder, as the case may be, and the fibres of the wool are broken, separated, straightened, and operated upon, and the knobs of wool are disentangled, so as to card the wool better and more effectually than it can be done in the ordinary way."

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43. For a machine for *Manufacturing Lead Pipes;* Joseph C. Vaughan, and Frederick Leach, Tioga, Tioga county, New York, December 31.

This is a rolling apparatus for rolling pipes of cast lead, so as to reduce them in size. There are four rollers consisting of disks of metal of the proper thickness for combining them together, so that they shall, when properly fixed, leave an opening at the place of junction of their peripheries, of the size and form of the exterior of the pipe; for this purpose their edges are fluted in such manner as that each constitutes a fourth of a circle. These four rollers are so placed as that they shall each stand at right angles to the two which are next to it, and they meet by a mitre joint at their edges. A vertical core, or mandrel, is fixed to the frame work of the machine, its lower end passing between the rollers. Upon this mandrel the cast lead pipe is to be placed, and the rollers being properly geared, and made to revolve, the pipe will be rolled out to the desired size. The mandrel is to be made hollow, so as to contain oil, a portion of which is allowed to ooze through small openings at its lower end.

"What we claim as our invention, is the employment of four rollers in combination with the fixed mandrel, in the manner, and for the purpose, herein described; and also the making of the mandrel hollow from the top to near the bottom, to contain oil, and provided with small holes to allow the oil to percolate, and thereby prevent the lead from adhering to the iron."

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44. For a *Cooking Stove;* John L. Lathrop, Provincetown, Barnstable county, Massachusetts, December 31.

This stove is to be made in the form of a Franklin, but is to be furnished with an oven, and other means of cooking; its appearance is therefore more like that of the old fashioned caboose, than of a Franklin stove. We shall not enter into any description of it, but only give the claim, which is to "the combination and arrangement of an upper and a lower diagonal partition, for the purpose of causing the smoke to pass around the oven, in the manner described."

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45. For a machine for *Cutting Nails;* Henry Waterman, city of New York, State of New York, December 31.

"The intent of this machine is to cut nails with a point somewhat of a blunt chisel form, and to give a shoulder on each side of the head by the cutters, thereby producing a nail that will enter easily, and drive and hold well; such mode of cutting being mostly applicable to that sort of nails called brads." This machine, however, is not intended to be confined to brads, but is to cut such nails also as are represented in the notice of Mr. Walter Hunt's patent, in the list for November, No. 11. The drawings of this machine consist of twelve different figures, by which it is fully represented. The claims are necessarily confined to the special construction adopted by the patentee, as every machinist acquainted with nail machines can construct them to cut such nails; nor is there any claim made to the kind of work performed, but only to the manner of performing it.

Specifications of American Patents.

Specification of a Patent for an Improved Manufacture of Cotton Twine; granted to Jacob Sloat, *Statsburg, Rockland county, New York, November 9th,* 1839.

To all whom it may concern: Be it known, that I, Jacob Sloat, have invented a new and improved manufacture of cotton twine, or cord, by which improvement the liability of such cord to kink, stretch, and untwist, is obviated, its durability is increased, and it is rendered equally applicable to various purposes, with the twine prepared from more costly materials; and I do hereby declare that the following is a full and exact description thereof.

I make my twine of various sizes, and by means of the apparatus ordinarily used for that purpose, and I then subject it to the operation of dressing, employing for this purpose any of the dressing machines used for dressing cotton yarn, to prepare it for being woven in the loom, the operation being similar, excepting that the twine or cord, instead of being wound upon a yarn beam, is to be delivered so as to be wound into balls, or otherwise put up for use. Various compositions of starch, gum, glue, or other materials possessing analogous properties, may be used for dressing, the object being to saturate or coat the twine or cord with any suitable viscous substance, which shall have the effect of causing the fibres of cotton to adhere to each other, and consequently to prevent the kinking, stretching, and untwisting of the strands. I have found a mixture of starch and glue to answer the intended purpose perfectly well, and are not aware that any other material is to be preferred either for utility or economy.

I do not make claim to any new machinery to be used either in the process of spinning the twine or cord, or for the purpose of applying the viscous dressing thereto; but what I do claim as my invention is the applying of the well known process of dressing, to cord or twine prepared from cotton in the ordinary way, whereby such cord or twine is greatly improved in its useful properties, and is thereby rendered an essentially new manufacture.

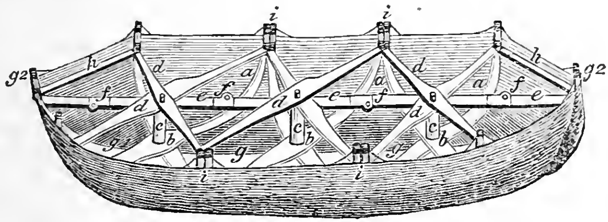
Jacob Sloat.

Specification of a Patent for a Portable Safety Barge and Army Boat; granted to Solomon C. Batchelor, *city of Cincinnati, Ohio, January 20th,* 1841.

To all whom it may concern, be it known, that I, Solomon C. Batchelor, of the city of Cincinnati, in the State of Ohio, have invented an improved boat, which I denominate the portable safety barge and army boat, and I do hereby declare that the following is a full and exact description thereof. My boat or barge is so constructed as to be capable of being doubled up so as to occupy a very small space when it is not in use as a boat. The exterior, instead of planking, consists

of India rubber cloth, or of any other flexible material which is light, readily folded, and impervious to water. When opened out for the purpose of being used, the sides are sustained by suitable ribs of timber, constructed and jointed together in a way to be presently described.

The portion of timber forming the keel is divided into lengths which are connected together by rule joints; and another portion of timber which extends fore and aft, or from stem to stern, directly above the keel and near the upper part of the boat, is in like manner divided and connected by rule joints, so that they may be doubled together, and when opened out, the respective pieces will stand in a straight line, or nearly a straight line; the rule joints connecting the several parts of this timber are so constructed as to open a little beyond a straight line, this forms a kind of lock, as this part acts as a longitudinal stretcher; the two end pieces of the keel curve up so as to constitute a stem and stern post.



The accompanying drawing represents my boat, or barge, in perspective. The pieces of timber which constitute the ribs of my boat or barge, and which are marked *a*, *a*, *a*, consist of hickory, ash, white oak or other tough hard wood, adapted to the purpose; these pieces are to be bent into the form of a bow, so as to constitute, when properly placed, the cross bottom timbers and ribs of the boat; they must, of course, be of such length as will adapt them to the particular purpose to which they are to be applied. These rib pieces are placed in pairs, crossing each other at their middles, as shown at *b*, *b*, *b*, where they work upon joint pins, formed by the lower ends of the vertical standards *c*, *c*, *c*, each of these rib pieces is connected together near its upper end, by a straight stretcher of wood *d*, and when in place, the retrospective pieces *d*, *d*, cross each other, and work on joint pins at the upper ends of the standards *c*, *c*, *c*. The upper fore and aft timbers are marked *e*, *e*, *e*, its parts being connected by rule joints at *f*, *f*, *f*, and it is also jointed to the cross pieces *d*, *d*, by the joint pin upon which they work.

The keel pieces *g*, *g*, *g*, are connected in like manner to the rib pieces *b*, *b*, and work upon joint pins passing through them, and through *b*, *b*, on the lower ends of the standards *c*, *c*; one of the curved end pieces of the keel is seen at g^1, and the upper ends of both of them at g^2, g^2. The two cross pieces *d*, *d*, which are nearest to the ends of the boat, are united by hinge joints to straight pieces of stem

and stern, or bow timber, *h, h,* which are hinged at their other ends to the stem and stern posts. Where two ribs meet at the sides of the boat as at *i, i, i,* they are united by hinge joints; and it will be readily seen that all the timbers may, from the arrangement of joints as above described, be folded together in such manner as that the length occupied by the boat when so folded, will be equal only to that of one of the bow pieces constituting the ribs, and the width only equal to that of three of the cross timbers *d, d,* and the thickness of the stern posts; that is, supposing there are three cross pieces to the boat, as in the drawing; but this number may be increased or diminished at pleasure. I have spoken of stem and stern posts; but these terms must be understood as convertible, the two ends of the boat being similar. A boat upon the foregoing plan, which I have constructed, weighs altogether thirty-five pounds, and it is capable of carrying, very readily, a load of two thousand pounds.

Having thus fully described the manner in which I construct my portable safety barge and army boat, what I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the pieces of timber forming the ribs, the cross pieces by which their ends are sustained, and the longitudinal pieces constituting the keel and the upper timber *e, e;* the respective parts being united by joint pins, hinge joints, and rule joints, substantially as herein set forth, so that the whole, when not in use, may be folded together, and be instantly prepared for use by the mere act of unfolding or opening.

SOLOMON C. BATCHELOR.

Specification of a Patent for a new Combination of Ingredients to be used as a Substitute for Oil, for Burning in Lamps; granted to ISAIAH JENNINGS, *city of New York, December* 31*st,* 1839.

To all whom it may concern, be it known, that I, Isaiah Jennings, of the city of New York, have invented or discovered a new combination of ingredients to be used as a substitute for oil and other combustible ingredients, for burning in the various kinds of lamps now in use; and I do hereby declare that the following is a full and exact description thereof.

In the process of distilling whiskey for making alcohol, or high wines, it is now the practice with some distillers to commence the operation by subjecting the whiskey in the still to a much more intense degree of heat than heretofore, and as the progress of rectification proceeds to lower the fire to the ordinary temperature. The effect of this high temperature is, in the first instance, to drive over a liquor possessed of peculiar properties, intimately related to those of the essential oils. The quantity of this liquor obtained from different parcels of whiskey, will differ, but I think that it will vary but little from two or three gallons to the hundred gallons of common whiskey. Its specific gravity is the same, as nearly as may be, with that of spirits of turpentine, and its reaction is, in many cases, similar. It is

extremely high flavoured, and brings over with it all the highly odorous matter contained in the whiskey, and has, consequently, an offensive smell. The reason for adopting this process by the distiller, is, that by driving over this oil, or spirit, which I shall designate by the name of *oil of whiskey*, the trouble and loss consequent upon rectification by charcoal, are avoided, and an equally pure spirit is obtained.

I have been thus particular in the foregoing description, as this peculiar kind of oil or spirit possesses the property of rendering alcohol and spirits of turpentine capable of combining with each other in proportions in which they do not combine when it is not present; and will also cause spirits of turpentine to combine with whiskey, or ordinary proof spirit.

In making my new compound, the spirits of turpentine may be the predominating ingredient, which cannot be the case when the compound of this spirit with alcohol is used alone. The proportions may, of course, admit of some variation, but the following is preferred. Two parts of spirits of turpentine; one of alcohol of 93° above proof, and one of oil of whiskey. Should alcohol of higher proof be used, the proportion of spirits of turpentine may be increased, but this is not deemed desirable. The advantage derived from this oil of whiskey is such, that were it not added, as above, the alcohol must exceed the turpentine in the proportion of about five to one.

I sometimes combine the oil of whiskey with sperm, or other oil, with turpentine, and with alcohol, or with the sperm oil alone; which last combination will take place in any proportions. When I use the four ingredients I prefer to take about four parts of the oil of whiskey, one of sperm or other oil, one of spirits of turpentine, and one of alcohol.

The fluid which I have denominated oil of whiskey, has, heretofore, been thrown away as worthless, but I have, as above stated, applied it to a highly useful purpose, and obtained a combustible fluid affording a brilliant light, at a cost far below that of the ingredients now in use, and which, when combined, as above stated, has not its offensive smell developed, but burns without odour.

What I claim as my invention or discovery, in the above named combination of ingredients, is the use and employment of what I have denominated oil of whiskey with spirits of turpentine, alcohol, or lamp oil, in the manner, and for the purpose, herein set forth.

ISAIAH JENNINGS.

Specification of a Patent for an improved manner of discharging Fire Arms of various kinds; granted to JOSHUA SHAW, *city of Philadelphia, January 30th,* 1841.

To all to whom it may concern: Be it known, that I, Joshua Shaw, of the city of Philadelphia, in the state of Pennsylvania, have invented a new and improved manner of discharging fire arms of various kinds, said improvement being equally applicable, under proper modi-

fications, to the discharge of small arms, such as pistols, fowling pieces, rifles, muskets, and others, and also to the discharging of pieces of ordnance.

In making the discharge, I ignite the powder constituting the charge by means of a percussion cap, charged with fulminating powder in the ordinary way; but when used for the discharging of small arms I employ percussion caps of a size considerably smaller than those in common use; and for the discharge of cannon they need not be larger than those now employed with small arms. A distinguishing feature of my invention is the manner of employing, or using, these caps, which, under all the modifications thereof, is by placing them upon one end of a cylindrical rod, or wire, of steel, which rod, or wire, for distinction sake, I will call a piston; and inserting said piston, with the cap on the end thereof, into a cylindrical opening occupying the place of the ordinary touch hole, or otherwise conveniently situated; said opening being adapted in size to the piston, which is to slide freely, but closely, within it. The cylindrical piston is to be a trifle larger in its diameter than the outside diameter of the cap which is to be placed upon it: its end being turned down, or reduced in size so as to pass into, and to be embraced by the cap. The hole or opening, into which the piston is to pass, is to contain, in some part of it, a piece or pieces of leather, cork, or other elastic substance, which is to embrace the piston, and thus render the passage air and water tight, whilst, at the same time, said material will serve, by its elasticity, to hold the piston in place.

In small arms the hole, or opening, through which the piston passes, may be of equal bore, or diameter, throughout; as the piston is, in some cases, to be of sufficient length to enter the chamber of the barrel, and to extend across it, so that the percussion cap which is placed upon its end may be brought into contact with the interior of the chamber on the side opposite to that at which it entered; and it is manifest that if the outer end of the piston be then struck by a hammer, or mallet, the percussion cap will explode, and the gunpowder will be ignited.

In pieces of ordnance there are sundry objections to the allowing of the piston to extend across the chamber of the gun; and from the thickness of the breach, in arms of this description, a sufficient depth is obtained in the solid metal for the operation of the piston without its entering the chamber of the gun. In using my piston with the percussion cap at its end for the discharging of pieces of ordnance, I bore a hole, in the manner, and generally in the place, of the ordinary touch hole, such hole being of the size of the piston intended to be used, say of three-sixteenths of an inch in diameter, more or less, and extending down nearly to the chamber of the gun, say within a fourth or half of an inch thereof; and through this remaining part I drill a hole of much smaller size, say one sixteenth of an inch, more or less, in diameter, until it enters the chamber. The piston must be of such length as to extend down to the bottom of the larger portion of the bore, and to rise to a sufficient height above the top of it for the action of the hammer by which it is to be struck. Its lower end, or that which

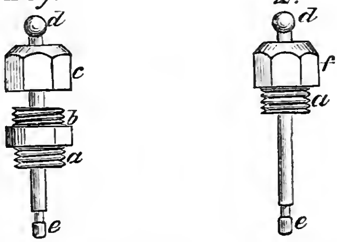
enters the bore, is, as above stated, to be turned down so as to form a nipple for the reception of the percussion cap.

The percussion cap which I use under this modification of my invention, I have improved in such a manner as adapts it especially to the object in view; this improvement consists in the making a small hole, say one sixteenth of an inch in diameter, through the centre of what, in the ordinary cap, is its closed end; this being done before the cap is charged with percussion powder.

When the piston is inserted in the bore, having a percussion cap of the kind just described on its lower end, if the piston be struck by a hammer, or mallet, on its upper end, the cap will explode, and the ignited percussion powder will pass through the hole in the head of the cap, and through the small part of the bore under it, into the chamber of the cannon, where it will ignite the powder.

I sometimes drill a small hole into the end of the piston, in the direction of its axis, which hole may be from an eighth to a fourth of an inch in depth, and of the same size with that in the percussion cap, and also with that leading into the chamber of the gun; this hole is to be filled with common gunpowder, which will be ignited by the percussion powder; by using this device the percussion caps may be very lightly charged with purcussion powder, the gunpower greatly aiding in causing the discharge of the cannon. This is a point of considerable importance, as the destructive influence of the percussion powder upon the parts with which it is in direct contact, is thereby, to a considerable extent, obviated. It may also be remarked that the percussion cap which remains upon the piston after the discharge, has the effect of protecting it, and the adjacent parts, from injury by the percussion powder.

Fig. 1. 2.



I will now exemplify, by reference to the accompanying drawings, the manner in which my improvements may be carried into actual operation. Figs. 1 and 2, represent modes in which it may be conveniently applied to small arms; in fig. 1, *a*, is a perforated screw nut, which screws into the barrel, at the place usually occupied by the touch hole, or in any other preferred situation; the end of this screw is to be flush with the inside of the chamber; *b*, is a screw on the upper part of this nut, upon which there is fitted a screw cap *c*; the cavity in this cap is somewhat deeper than the length of the screw *b*, in order to admit of the insertion of a piece of leather, or of some other elastic substance, through which the stem of the piston *d*, *e*, is to pass. This stem is to be made perfectly cylindrical, and the holes in the nut and

cap through which it passes are to be made perfectly true, and adapted nicely to it in size, so that such pistons may slide in and out easily, and yet have no shake. Fig. 2, shows a similar device, but more simple in its construction; *a*, is a screw nut which screws into the barrel, but does not pass through into the chamber, there being a solid portion of the barrel below it, with the exception of an opening of such size only as to admit the piston to pass through it. The elastic material, under this arrangement is placed beneath the screw *a*, and is pressed between it and the part of the barrel beneath it. The head *f*, of this screw nut, together with its screw part *a*, receives the piston *d*, *e*, as in fig. 1, its whole construction and operation being substantially the same. The length of this piston is, under this arrangement, to be such as to extend across the chamber of the piece to be discharged. The small percussion cap is received on its inner end *e*, and this must be, as before remarked, somewhat smaller in diameter than the piston. These percussion caps are, in other respects, constructed in the ordinary manner.

Any required number of these pistons, armed with their caps, may be conveniently carried by arranging them in holes prepared for their reception in the stock, or breeching part of the gun or pistol, or they may be disposed of in any way which will admit of their being readily applied when wanted.

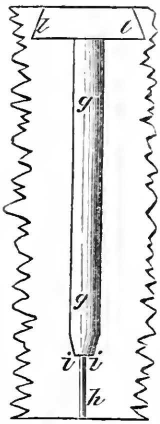


Fig. 3.

Fig. 3, is a section through the touch hole part of the breech, or ventfield of a piece of ordnance, showing the manner in which I drill or bore through this part for the insertion of the piston, and the exploding of the cap; and fig. 4, is the piston; *g*, *g*, is the part of the bore which is to receive the cylindrical piston fig 4; and *h*, the lessened aperture leading from the lower end of *g*, *g*, into the chamber of the gun, thus leaving a shoulder at *i*, *i*, against which the percussion cap is to be forced when the discharge is to take place. I have said that the bore *g*, *g*, should be perfectly cylindrical, and this is true, excepting that there is a slight contraction at its lower end, in the part which embraces the percussion cap at the time of the explosion; this part being made slightly conical, to the height of from an eighth to a quarter of an inch, which causes it to embrace the cap the more closely after the blow, and still allows it to be readily withdrawn, as the slightest motion relieves it from the conical termination.

I have, in the application of my improvement to cannon, devised a very simple mode of using an elastic substance through which the piston is to pass, and by which the entrance through the opening *g*, *g*, is rendered air and water tight. I make a countersink *l*, *l*, at the upper end of the bore *g*, *g*, in which I insert a piece of cork, having a

hole through the middle of it, through which hole the piston will pass, and by which it will be closely embraced. This cork may be firmly held in place by small asperities on the sides of the countersink, by widening the countersink a little towards its bottom, or in various other ways. If preferred an elastic substance may be held down by means of a perforated screw nut inserted in the ventfield, but I think the cork, inserted as above described, is, as I have found it to be, perfectly efficient, and it may be readily and instantaneously renewed. I prefer, in all cases to make the pistons of tempered steel; they are accurately turned, ground, and fitted to the perforations prepared to receive them. In fig. 4, *n*, is a section of the copper cap which is to be placed on the lower end of the piston *m*, *m*, this cap is perforated at *o*, prior to its being charged with percussion powder, the opening being equal in size, or nearly so, to the perforation at *h*. The lower end *p*, of the piston is turned down to receive the cap, and it is diminished in diameter at the part *q*, so as to leave a shoulder at *r*, above which the copper cap rises, and the upper edge of the cap is to be slightly bent inwards so as to embrace this shoulder; and this may be readily effected by holding a piece of steel, say one of the pistons, or a tool kept for the purpose, upon the edge of the cap after it is in place, and rolling it over upon a table. By this means it is made to embrace the piston so firmly as to insure its being withdrawn with it, after the discharge; whilst without this precaution it would be liable to be left behind. The dotted lines at the lower end of the piston show the perforation sometimes made for containing gunpowder.

The discharge is made by allowing a hammer to strike on the head *d*, of the piston, and this may be done by hand, but it will usually be effected by means of a lock, constructed in any convenient form, and adapted to the piece to which it is to be applied.

Having described the manner in which I apply my piston, and its percussion cap for the discharge of pieces of ordnance, I will now observe that I intend sometimes, and shall probably prefer, to adopt a similar arrangement in small arms; that is to say, to use a piston which shall not enter the chamber of such arms, but which shall be contained entirely within the tubular screw nuts, represented in figs. 1 and 2, or within tubular pieces analogous thereto. In this case I shall use also, the perforated percussion caps, like those used for the discharge of cannon, and allow the percussion powder to pass therefrom into the chamber of the pistol, or the gun, through a perforation smaller than that which receives the piston. The whole arrangement of the apparatus being in this case substantially the same with that described in my application of it to cannon; the main difference being in the size only of the respective parts.

From the smallness of the opening through which the discharge is made from the percussion cap into the powder forming the charge, or from the smallness of the section of the piston used in small arms, when said piston is allowed to pass through the chamber, the reaction from the discharge, tending to throw the piston out, will be but small, and it will be held down by the force of the spring acting upon the hammer of the lock, when a lock is used. When the piston is to be

struck by hand, a button attached to the ventfield of the gun, and bearing on the piston near its upper end, may be used for checking the rise of the piston from the force of the discharge.

5.

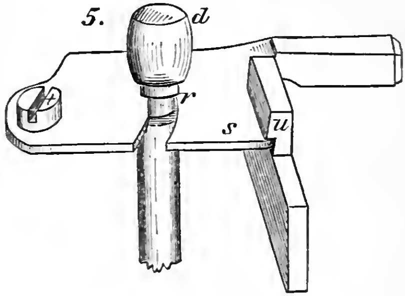


Fig. 5, shows the manner in which the button may be affixed; *d*, is the head of the piston, and immediately under this head there is a shoulder *r*, made by turning the shank of the piston so as to form a neck smaller than the shank; *s* is a steel button which turns on a screw at *t*, and passes under a catch *u*, at its opposite end. The neck of the piston is embraced by the notch in the button *s*, and is thus held from being blown out. The neck is of sufficient length to give the requisite play to the piston, which can be drawn out when the button is turned back.

In cannon and other fire arms constructed as herein described, the vent is not only rendered air and water tight, but the escape of fire and smoke through it is effectually prevented, as has been proved by numerous trials.

Having thus fully described the nature of my improvement, and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is the effecting of the discharge of fire arms by placing a percussion cap on the end of a cylindrical rod, or piston, formed for the purpose, in the manner herein set forth; such piston, with its cap, being made to pass through an opening adapted thereto, either in the body of the breech of the piece to be discharged, or through tubular pieces screwed into, or otherwise attached to it; said piston being of such length as shall adapt it to the respective modifications of my apparatus, as above described; that is to say, I claim the passing of such a piston through a tubular opening allowing it to reach across the chamber, as in my first described modification. Or I pass it into a cylindrical opening extending nearly to the chamber where a shoulder is formed by diminishing the size of the aperture, in the manner, and for the purpose set forth; the respective parts concerned in the discharge, being constructed, and operating substantially as herein fully made known. I claim, likewise, the improvement in the percussion cap, consisting of the perforation through the middle of what is usually its closed end, in the manner, and for the purpose described.

Joshua Shaw.

Progress of Practical & Theoretical Mechanics & Chemistry.

Electricity from Steam.

At a stated meeting of the American Philosophical Society, held December 18th, 1840, Dr. Patterson called the attention of the Society to the subject of the evolution of electricity from steam, mentioned at the last meeting, and stated that the experiments made lately in England had been successfully repeated by Mr. Peale, Mr. Saxton, and himself, at the United States' Mint.

Dr. Patterson said, that their first attempts were to collect electricity from the steam as it issued from a gauge-cock, near the surface of the water, in the boiler; but in this case the steam was always accompanied by a spray of water, and the experiments failed. They also failed when the steam was of a low temperature, as it was then condensed immediately upon leaving the boiler, so as to form a cloud of vesicular vapour. In both these cases, the electricity, if evolved at all, would be led back to the boiler—the spray and the vesicular vapour being, as is well known, electrical conductors.

When, on the other hand, high steam was drawn off from a stop-cock far removed from the water in the boiler, it was observed to issue, for some distance, in the form of a transparent gaseous vapour, and, in this case, any insulated body on which it was condensed was always found to be charged with electricity. Thus, if the experimenter stood on an insulating stool, or even on a box or ladder of dry wood, and held an iron ladle, or any other conductor, in the issuing steam, the conductor and the operator became so fully charged with electricity, that thick sparks of a half, three-quarters, and in some instances a whole inch in length, were drawn off; the Leyden jar charged; the shock given to several persons holding hands, &c. The electricity thus produced was found to be always positive.

Dr. Patterson said, that one of the most important conclusions to which the experiments had led, was, that true gaseous steam is a non-conductor of electricity. If it had not been so, the apparatus would not have been insulated, and the electricity excited would have been carried back to the metallic boiler, and thence to the earth.

Dr. Patterson thought it most probable that the electricity, in these experiments, was evolved by the condensation of the steam—the phenomenon being analogous to the evolution of latent heat by the same condensation. He remarked, that as the steam within the boiler was surrounded by conductors, it could not be supposed to contain free electricity, and that on leaving the boiler, the only sources to which the electricity could be ascribed, seemed to be the condensation of the steam, the oxidation of the iron against which it impinges, or the friction of the steam against the air as it rushes through it.

To show that oxidation was not the source of the electricity, the experimenters caused the steam to strike upon a large bar of fine gold (400 oz. in weight,) and the generation of electricity was as abundant

as when they employed an oxidizable metal. The electricity was also evolved by the insulated operator simply holding his hand in the steam as it issued; in which case the steam was condensed upon the hand, and the whole person became charged. Dr. Patterson stated, that this was, in fact, the experiment accidentally made near New Castle, in England, and which has attracted so much attention.

To show that the electricity was not caused by the rushing of the vapour through the air, Dr. Patterson said, that an apparatus was made, consisting of a pipe connected with the stop-cock on the boiler, a portion of about ten inches in length, near the upper end, being of glass, to produce insulation, and the remainder of lead, wound into a helix, like the worm of a still. This helix was immersed in a bucket of water and snow. When the steam was admitted, it became entirely condensed within the pipe, so that there was no rush through the air; yet the production of electricity was as abundant as with the former arrangements.

Dr. Patterson took notice of experiments made, half a century ago, by Volta and Saussure, and afterwards by Cavallo, which proved, to their satisfaction, that electricity was evolved during evaporation and condensation, but which have since been called in question by Pouillet and others, who assert, that a mere change of state, not accompanied by chemical change, never gives rise to electricity. He considered the experiments, now made on a large scale, as favouring, if not confirming, the first opinions entertained on this subject.

Dr. Patterson referred to the satisfactory manner in which these new experiments seem to explain the sources of electricity in the thunder storm, and in volcanic eruptions.

He then related an experiment in which an insulated iron ball, and afterwards a bar of gold, was heated, and a small stream of water poured on it, so as to be formed into steam at its surface. The first experiments seemed to show that the metal was charged with negative electricity, but subsequent trials threw doubts upon this conclusion.

Dr. Patterson also described experiments made to determine whether electricity was given off during the solidification of liquids,—the substances used being melted lead, silver and gold. In every case, however, the gold-leaf electroscope failed to exhibit the presence of any electricity.

Prof. Henry stated that he had not seen the sparks from steam; but that he had obtained feeble electricity from a small ball, partly filled with water, and heated by a lamp. He agreed with Dr. Patterson in the opinion, that the source of the electricity was the change of state, but from water to vapour. There was, however, some doubt on the subject; Pouillet had denied the evolution of electricity from the evaporation of pure water. The facts were interesting, particularly on account of the great intensity of the electricity. The results, obtained by the philosophers, which had been mentioned, indicated electricity of very feeble tension, which could only be observed by the most delicate instruments, but here the sparks were an inch in length. If the vaporization of the water were shown to be the source

of the electricity, Prof. Henry thought that the phenomena might be readily explained by the beautiful theory of Becquerel, in regard to the production of the great intensity of the electricity in the thunder cloud. According to this theory, each particle of the vapour carries up with it into the atmosphere the free electricity, which it receives at the moment of the change of state; this, being diffused through the whole capacity of the air, is of very feeble intensity, although of great quantity; but the condensation of the vapour into a cloud affords a continuous conductor, and consequently the electricity of all the particles of the interior, according to the well known principles of distribution, rushes to the surface of the cloud, and hence the great intensity of the lightning. According to this hypothesis, the insulated conductor, placed in the steam, would act not only as a collector, but also as a condenser of the free, but feeble, electricity of the vapour.

Prof. Henry farther stated, in connection with this subject, that he had been informed by several persons, that they had obtained sparks of electricity from a coal stove during the combustion of anthracite. A case had been stated to him several years ago, which he mentioned to his friend Professor Bache, who informed him that a similar one had fallen under his own notice, in which, however, Prof. Bache had succeeded in tracing the electricity to the silk shirt of the person who drew the spark. Another case had lately been reported to him by an intelligent gentleman, of a stove burning bituminous coal, on board of a steamboat on the Ohio, which afforded amusement to all the passengers during the voyage, by giving sparks of electricity whenever it was touched.

In connection with the facts that had been stated of the production of electricity from steam, Prof. Henry observed that he was now inclined to believe that electricity may also be evolved during the combustion of coal in a stove. But what, he asked, is the source of electricity in this case? Is it combustion, the evaporation of the moisture, or the friction of the hot air on the interior of the pipe?

Dr. Goddard stated, that in the case of a stove, pretty well insulated, his family had amused themselves with drawing sparks half an inch or three quarters of an inch long; and that similar sparks were obtained from the frame of a looking-glass over an open grate, in the house of Dr. Norris, of this city.

Professor Bache remarked, that in the case referred to by Professor Henry, in which sparks of electricity were obtained from a stove, he had satisfied himself that these were owing to the experimenter wearing a silken shirt:—an experimenter, not similarly clad, being unsuccessful.

Dr. Hare ascribed the incredulity and the opinions which he had expressed, when this subject was brought before the Society by Mr. Peale, at the last meeting, to a misapprehension, on his part, as to the circumstances. He considered that the fact of electricity being developed in the case adduced was established. He alluded to the almost incredible case of a lady, who, agreeably to evidence mentioned in Silliman's Journal, gave off sparks of electricity. He stated also the result of an experiment to discover whether electricity was given

off during the rapid evaporation of a saline solution. There was no evidence of excitement. The vessel was of glass.

Mr. Lea had frequently observed sparks from a common grate.

In reference to the results of experiments by Dr. Patterson, in which no evidence of the development of electricity was observed in metals, whilst undergoing a change from the liquid to the solid state, Dr. Goddard observed, that in cases of crystallization on the large scale, as of nitre, in the extensive chemical works of Mr. Wetherill, a beautiful flash of electrical light was apparent.

Professor Rogers suggested, that in ordinary combustion there may be a constant development of electricity, and that means may possibly be found to render it apparent by perfect insulation.

Professor Henry stated, that Pouillet had found that electricity is developed by the combustion of charcoal, and he offered some suggestions as to the mode of rendering the electricity, given off from a stove, apparent, by insulating it both above and below.

Dr. Emerson thought, that the change of state from solid to liquid, and from liquid to solid, might account for various electrical phenomena presented by the animal body. Dr. Hare suggested the difficulty, that the human body is a good conductor; and that without a peculiar organization, analogous to that with which nature has endowed the Torpedo or Gymnotus, it is inconceivable that electrical discharges could arise from vital organization. He believed it was admitted by electricians, that there could be no electrical excitement without the existence of the opposite electricities. Agreeably to the published facts of the case to which he had alluded, the lady was permanently in one state of excitement, generating electricity, as animal heat is generated, and throwing off the excess in sparks.

In the case of the Gymnotus the intensity, Dr. Hare remarked, is so low that sparks are with difficulty rendered apparent at a kerf made by a knife in tinfoil; of course, the sparks alleged to be given by the lady were vastly more intense. From the Gymnotus, sparks could only be received by forming a circuit with a portion of the organic series situate parallel to the spine. Contact in a transverse direction was not productive of any discharge.

Proceedings Amer. Philos. Soc.

Corrosion of Cast Iron and Wrought Iron in Water. By ROBERT MALLET, A. I. C. E., *&c.*

[From the "Transactions of the Institution of Civil Engineers."]

This communication is one of those forwarded to the institution in consequence of the council having considered this subject a suitable one to compete for the Telford Premiums; and the author having been long engaged in making experiments on this subject, at the request of the British Association, refers, in the introductory part of this paper, to the contents of that report, which may be viewed as a "*précis*" of the state of our knowledge on the subject to the year 1839, together with original researches, forming the basis of the present results. This communication is accompanied by a most elabo-

rate set of tables of results; but these laborious investigations being yet in progress, the author directs his special attention to so much only of the subject as may be necessary for their elucidation—divesting his remarks as much as possible of a purely chemical character, and confining them to those practical conclusions which are of immediate use and importance to the engineer.

The tables of results are altogether twelve in number. The first five contain the data and results of the chemical or corroding action of sea and fresh water on cast and wrought iron under five several conditions, during a period of a year and ten months; and these five series of experiments are so co-ordinate with each other as to form one connected and comparable whole, whence the relative rates and absolute amounts of corrosion of cast and wrought iron—by, 1, clear sea water; 2, foul sea water; 3, clear sea water at temperature 115° F.; 4, foul river water; and, 5, clear river water—may be ascertained. The corrosive action of water and air combined produces on the surface of cast or wrought iron a state of rust possessing one of the five following characteristics—1, uniform; 2, uniform with plumbago; 3, local; 4, local pitted; 5, tubular—or of two or more of these characteristic conditions in combination; these facts, for eighty-two different specimens of British and Irish cast iron, together with their original external characters, mode in which they were cast, specific gravity, dimension and weight before and after immersion, loss of weight per square inch of surface—this loss referred to a standard bar, and the weight of water absorbed for clear sea water, compose Table I. The four subsequent tables contain similar results for specimens of iron immersed under the other four conditions mentioned above. These five tables contain also the results of the corrosion of certain cast irons protected by either of ten several paints or varnishes, the results of which are comparable with those for the unprotected iron. Table VI. exhibits a general comparison of the results set forth in the preceding tables for specimens of iron one inch thick, and reduced to one common or equal period of immersion. Table VII. shows the average loss of all varieties of cast iron experimented on per square inch of surface. Table VIII. the average calculated amount of corrosion (assumed uniform) of various specimens of cast and wrought iron per superficial foot of surface at the end of one century. From these tables it appears that the metallic destruction or corrosion of the iron is a maximum, in clear sea water, of the temperature of 115° F.—that it is nearly as great in foul sea water—and a minimum in clear fresh river water.

Iron, under certain circumstances, is subject to a peculiar increase of corrosive action—as, for instance, cast iron piling at the mouth of tidal rivers—from the following cause. The salt water being of greater density than the fresh, forms at certain times of tide an under current, while the upper, or surface water, is fresh; these two strata of different constitution coming in contact with the metal, a voltaic pile of one solid and two fluid elements is formed; one portion of the metal will be in a positive state of electrical action with respect to the other, and the corrosive action on the former portion is augmented.

The lower end of an iron pile, for instance, under the circumstances just mentioned, will be positive with respect to the other, and the corrosion of the lower part will be augmented by the negative state of the upper portion, while the upper will be itself preserved in the same proportion. From this theoretical view may be deduced the important practical conclusion, that the lower parts of all castings, subject to this increased action, should have increased scantling.

The increased corrosive action of foul sea water may be referred to the quantity of hydrosulphuric acid disengaged from putrifying animal matter in the mud, converting the hydrated oxides and carbonate of iron into various sulphurets, which again are rapidly oxidised further under certain conditions, and, becoming sulphates, are washed away—hence the rapid decay of iron in the sewage of large cities, and of the bolts of marine engines exposed to the bilge water. The corrosive action being least in fresh water, may be partly referred to this being a worse voltaic conducting fluid than salt water.

It appears also that wrought iron suffers the greatest loss by corrosion in hot sea water—which fact has led the author to inquiries, with reference to marine boilers, at what point of concentration of the salt water, whether when most dilute, after the common salt has begun to deposit, or at a farther stage of concentration, the corrosive action on wrought iron is the greatest, and he points out the important practical use which can be made of this information. It appears also, that the removal of the exterior skin of a casting greatly increases the corrosive action of salt water and its combined air, so that the index of corrosion under these circumstances is not much less than that of wrought iron, and in clear river water is greater.

It farther appears, that chilled cast iron corrodes faster than the same sort of cast iron cast in green sand, and that the size, scantling, and perhaps form of a casting, are elements in the rate of its corrosion in water. The explanation of these facts is to be found in the want of homogeneity of substance, and the consequent formation of numerous voltaic couples, by whose action the corrosion is promoted. It is also observable that the corroded surface of all these chilled specimens is tubular.

It appears also, that in castings of equal weight, those of massive scantling have proportionately greater durability than those of attenuated ribs and feathers—hence appears also the great advantage of having all castings (particularly those intended to be submerged) cooled in the sand, so as to insure the greatest possible uniformity of texture. The principles now stated afford an explanation of the fact often observed, that the back ribs of cast iron sheet piling decay much faster than the faces of the piles. It is also probable that castings in dry sand and loam will, for these reasons, be more durable than those cast in green sand. The general result of all these experiments gives a preference to the Welsh cast iron for aquatic purposes, and to those which possess closeness of grain. Generally, the more homogeneous, the denser and closer grained, and the less graphytic, the smaller is the index of corrosion for any given specimen or make of cast iron.

Mining Jour.

New method of Analysing Sulphurous Waters.—Iodine as a test for Hydro-Sulphuric Acid.—Sulpho-Hydrometer. By M. Alphonso Dupasquier.

Being occupied in making a complete history of the fine establishment which has lately been founded near the sources of Allevard (Isere,) M. Dupasquier has devoted himself, with peculiar care, to the analysis of the sulphurous water which they so abundantly yield. He has studied it very accurately, and his investigations have led to the discovery of a process, as simple as delicate, for detecting and ascertaining the proportion of hydro-sulphuric acid, free or combined, contained in mineral waters.

Tincture of iodine, poured into a liquor impregnated with hydro-sulphuric acid, completely decomposes that acid, and so instantaneously, that it is very easy to ascertain the point at which its decomposition is finished, and when the iodine no longer enters into combination. Setting out from this observation, which is his own, it occurred to M. Dupasquier that, by using a carefully prepared tincture of iodine, he might be able, from the quantity of iodine required for saturating a quart of sulphurous water, to deduce the proportion of free or combined hydo-sulphuric acid which it contained.

This opinion has been confirmed by experiment, and M. D. has rendered his new method of analysis extremely convenient, by means of an instrument which he calls a sulpho-hydrometer. This instrument is a graduated tube, filled with tincture of iodine, one extremity of which is closed by a cork, whilst the other is tapered, and terminates in a capilliary aperture, which allows the tincture of iodine to run out, drop by drop, when the cork is removed.

To use the sulpho-hydrometer, a given quantity of sulphurous water is poured into a porcelain capsule; a few drops of a very clear solution of starch are then added; then the tincture of iodine is gradually dropped into it, taking care to assist the action by stirring. So long as any traces of hydro-sulphuric acid remain, the iodine deprives it of hydrogen, precipitating its sulphur, and immediately disappears, without colouring the starch; but from the time that the saturation is complete, the least trace of free iodine is sufficient to communicate to the liquor a fine blue colour. The number of degrees that the tincture of iodine is lowered in the sulpho-hydrometer, must then be reckoned; each degree represents one centigramme of iodine, and each tenth of a degree one milligramme. The quantity of iodine necessary to saturate a quart of sulphurous water being thus given, it is very easy to ascertain how much hydro-sulphuric acid the water contained, by determining the equivalent of the iodine in the hydrogen, the volume of which being known, we have that of the hydro-sulphuric acid.

To render the use of his instrument more easy, M. Dupasquier has prepared a table, indicating in weight and bulk, the quantity of hydro-sulphuric acid, represented by 1, 2, 3, &c., 100 centigrammes, 1, 2, 3, &c., milligrammes of iodine.

This mode of analysis, independent of giving results of the strictest accuracy, has also the advantage of being so expeditious, that fifteen

or twenty experiments may be made in less than an hour. It is also so simple, that it is not necessary to be a chemist to determine the proportion of hydro-sulphuric acid contained in a mineral water; any intelligent person may ascertain the variations in the strength of sulphurous waters, caused by atmospheric influences, or by the mixture of rain water. Among other advantages which this method presents, M. Dupasquier holds up to notice its extreme delicacy, which is so great, that it indicates the precise quantities of hydro-sulphuric acid in waters on which other re-agents would have no action, although they evidently exhibit a sulphurous character. Tincture of iodine may, indeed, he has ascertained, unequivocally detect one drop of a concentrated solution of an alkaline hydro-sulphate, diluted in a hectolitre of water, whilst known re-agents become powerless when it is diluted in ten quarts.—*Annales de Chimie et de Physique.* Mining Rev.

Patent Wire Rope.

It has been our desire to enter more fully into the merits of this patent than we had space on the former occasion, when directing attention to its applicability, both with regard to economy and security for our mines, but we have not yet been in a situation to afford a notice so satisfactorily as we could wish, the information we contemplate receiving not having come to hand. In its absence we have only to note the additional trial made at the Chain Cable Proof House, at Withymoor, near Dudley, on the 25th ult., of which the following is a copy of the certificate signed by Mr. Lewis, the proprietor of the machine:—

Description.	Size.	Bore without Breaking.	Broke at	Second Breaking.	Third Breaking.	Weight per Fathom.
	Inches.	Tons.	Tons.	Tons.	Tons.	lbs. oz.
Flat	4 by ½	11	11½	6	3	7 6
"	3½ by ⅜	7	7½	4	1	4 15
"	3 by 3-16	2	2½	2	..	2 5
Round	3-inch.	16½	17	8	3	7 0
"	2½-inch.	12	13	5	2	5 13
"	1¾-inch.	6½	7	4	1	2 13

From this it will be seen that, in addition to the strength of tension employed previous to breaking, instead, as in the case of cable or hempen rope, of its breaking short, it required three separate strains to break it entirely. We have been favoured with a letter from a friend in the north who has just received some, and who promises to advise us of the results of trial to which he intends to submit it. Specimens of the various descriptions may be seen at the Polytechnic Institute, Regent street, and at the Adelaide Gallery, as also at our office. The increasing demand for the article, and the test it has borne of some years' trial by the Admiralty, is the best report upon, and evidence of, its superiority. We should think it peculiarly well adapted for the London and Blackwall Railway, where, we understand, the rope has

snapped some half-dozen times. The size of the rope used there is, we believe, 6½ in., and the cost of a single rope 1250*l*. Mining Jour.

New Process for Making Sulphuric Acid.

M. Provostaye, of Paris, has proposed the following process:—He recommends introducing into the leaden chamber sulphuric acid, nitric acid, and the vapour of water. To understand what takes place under these circumstances, a current of sulphurous acid may be passed into a flask containing nitric acid; this should be made, by means of a bent tube, to communicate successively with a flask containing sulphuric acid, a globular vessel moistened with water, and a dry globe. The nitric acid is completely decomposed. The first flask contains pure sulphuric acid alone. Red vapours pass from the first vessel into the second: this is filled with sulphurous acid also, for it is formed of solid white crystals, in the two last experiments, as in the first. In the latter, all the sulphuric acid of the second flask exists in a solid crystallized mass, of a greenish yellow colour. The re-actions are, therefore, similar to those of the old process. In the new process, the nitric acid yields a portion of its oxgen to the sulphurous acid, in order to convert it into sulphuric acid. Hyponitric acid is thus formed, which acts like the hyponitric acid in the old process, which is formed from the binoxide of azote and oxygen of the atmosphere—that is to say, successively it yields oxygen to the sulphurous acid, and borrows it from the air: but the discharge requires the intervention of sulphuric acid and water. The water has two very distinct functions, it acts directly, by bringing into more intimate contact the sulphurous acid and hyponitric acid, and this favours the oxidation of the first by the oxygen of the second; it acts also by decomposing the white crystals immediately, and changing them into sulphuric acid and oxide of azote. Ibid.

Cornish Engines.

A deputation from the Dutch government having visited Cornwall in order to ascertain, by actual inspection, whether the duty performed by the steam engines employed in the mines is equal to what is stated in the monthly reports, the adventurers and agents of the undermentioned mines kindly permitted an experiment of six hours to be made on their several machines, and the duty as stated below was the result:—Wheal Vor, Borlase's engine, 80 inches single, 8,0 feet stroke, 123,300,593 lbs. lifted one foot; Fowey Consols, Austen's engine, 80 inches single, 9,0 feet stroke, 122,731,766 lbs. lifted one foot; Wheal Darlington engine, 80 inches single, 8,0 feet stroke, 78,257,765 lbs. lifted one foot; Charlestown United Mines, 50 inches single, 7,5 feet stroke, 55,912,392 lbs. lifted one foot; Charlestown United Mines Stamping engine, 32 inches single, lifting 66 stamps, 60,525,000 lbs. lifted one foot; Wheal Vor Stamping engine, 36 inches double, lifting 72 stamps, 50,085,000 lbs. lifted one foot.—*Lean's Engine Reporter.*
Railway Mag.

Progress of Physical Science.

Geological Specimens found on the Great Western Railway.

During the formation of the line, there were numerous difficulties to encounter, in respect of the number of tunnels, there being no less than five, which, of course, presented a wide field for the geologist. The finest specimens of any antediluvian remains were those of an Icthyosaurus, found in a bed of blue lias limestone, presenting the head, teeth, vertebræ, and ribs, in a most perfect state, the length being from twelve to fifteen feet. The bed of stone in which it was found was broken in half, on account of its immense thickness, for the better enabling its removal with safety. It is still in possession of the Great Western Railway Company, at Bath. Various specimens of the cornua ammonia were also found of all sizes, some of very large dimensions, and others much smaller, appearing as having just come from the hands of the gilder, being covered with a mineral incrustation, and generally found in a bed of wet blue marl.

Near the foundation of an old Roman villa (an account of which appeared in our Journal at the time) were discovered the tusks of an elephant, buried about twenty-five feet in a bed of gravel, which, from its appearance, could not have been removed or disturbed for centuries; and whether deposited there at the Flood, or at some later period (most likely during the earlier part of the Roman sway in this country) must remain for more experienced geologists than myself to decide. Near the same spot was discovered an old stone coffin, formed so as to contain three bodies, being built of the oolite or Bath stone, and which, upon being opened, presented to view a small quantity of bones.

It has often afforded me matter for wonder, that amongst the directors and shareholders of some of our leading railways, something has not been done at the different stations for the establishment of a Museum, in which a collection of all specimens found on the different works should be kept open for the benefit of the passengers and the public in general.

Mining Jour.

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*Abstract of the Proceedings of the Physical Section of the British Association, at the Glasgow Meeting.**

CONTINUED.

Propagation of Heat through different Strata.

Professor Forbes finds from the mean of experiments made in 1837, 8, and 9, upon the propagation of the heat received from the sun's rays through strata, consisting of trap rock, pure loose sand, and sand stone, the following rates of propagation.

* From the Proceedings given in the London Athenæum for October, 1840.

For one foot in depth, the relative rates of conduction are:—in trap, 7.4, in loose sand, 7.0, in sand stone, 4.4.

Cause of the Phenomenon in Vision called "Muscæ Volitantes."

Sir David Brewster has examined this phenomenon with the following results:

1. That in persons of all ages, and with the most perfect eyes, transparent filaments or tubes exist in the vitreous humour, at different distances from the retina. 2. That these filaments float in the vitreous humour, moving about with the motion of the head. 3. That these filaments are seen by means of their shadows on the retina, and are most distinctly visible in divergent light; these shadows being bounded by fringes produced by diffraction or inflexion. 4. That the real muscæ resembling flies, are knots tied, as it were, on these filaments, and arising from sudden jerks or motions of the head, which cause the long floating filaments to overlap and run into knots. 5. By making experiments, the limits of the motions of the muscæ; by measuring their apparent magnitude, and producing double images of them by means of two centres of divergent light, the author was able to determine their exact place in the vitreous humour; and to ascertain the important fact that the vitreous humour in the living human eye is contained in cells of limited magnitude, which prevents any bodies which they contain from passing into any of the adjacent cells. Sir David Brewster concluded with the following observations. "I have dwelt thus long on the subject of the *muscæ volitantes*, not only because it is an entirely new one, but also on account of its practical utility. Mr. Mackenzie informs us 'that few symptoms prove so alarming to persons of a nervous habit, or constitution, as *muscæ volitantes*, and they immediately suppose that they are about to lose their sight by cataract or amaurosis. The details which I have submitted to you prove that the *muscæ volitantes* have no connection with either of these diseases, and are altogether harmless. This valuable result has been deduced from a recondite property of divergent light, which has only been developed in our own day, and which seems to have no bearing whatever of an utilitarian character; and this is but one of numerous proofs which the progress of knowledge is daily accumulating, that the most abstract and apparently transcendental truth in physical science will, sooner or later, add their tribute to supply human wants, and alleviate human sufferings. Nor has science performed one of the least important of her functions, while she enables us, either in our own case or in that of others, to dispel those anxieties and fears which are the necessary offspring of ignorance and error.'"

Report of the Committee on Combined Magnetic Observations.

The Committee reported that the series of simultaneous magnetic observations were now made at between thirty and forty stations,

including the two hourly observations during both night and day, and the monthly term observations, at intervals of two minutes and a half. Observatories have been established at Dublin, by the University, at Greenwich, Toronto, Upper Canada, the Cape of Good Hope, St. Helena, and Van Dieman's Land, besides two itinerant observatories of the Antarctic Expedition, by the British Government, at Madras, Simla, Sincapore, and Aden, by the East India Company, ten stations in European and Asiatic Russia, and one at Pekin, by the Russian Government, one at Prayree, and one at Milan, by the Austrian Government, one at the Girard College, at Philadelphia, one at the University of Cambridge, in New England, one at Algiers, by the French Government, one at Breslaw, by the Prussian, one at Munich, by the Bavarian, one at Cadiz, by the Spanish, one at Brussels, by the Belgian, one at Cairo, by the Egyptian, one at Trevandrum, by the Rajah of Travancore.

Magnetic Observatory at Munich.

Dr. Lamont gave an account of the magnetic observatory of Munich, stating that the building had been commenced in April of this year, and that the regular series of observations, comprehending both the two hourly daily observations, and the term day observations, were commenced on the 1st of August. The magnetic observatory of Munich differs in two respects from other establishments of the same kind. In the first place, it is not a magnetical house, but a subterranean building, which is situated to the S. W. of the royal observatory, at a distance of about 120 feet, and connected with it by a subterranean passage. The depth of the magnetic observatory below the surface of the earth, is 13 feet, thus affording the advantage of a temperature nearly equal, at all times of the year, and rendering the corrections applied to magnetic observations in order to reduce them to a fixed temperature, corrections which are, in general, subject to considerable uncertainty, if not unnecessary, at least sufficiently small to be determined with the utmost degree of accuracy. In the second place, the instruments are of greater dimensions than are usually employed in magnetic observatories, and may be considered as sufficient in all respects for the most delicate investigations. The magnetic bars weigh 25 pounds each, the theodolite has a circle of $2\frac{1}{2}$ feet diameter, and an achromatic telescope of $3\frac{1}{2}$ inches aperture. It may be remarked that the horizontal force instrument differs from the bifilar magnometer, the power that holds the bar in the direction perpendicular to the magnetic meridian, being that of a spiral spring.

Meteorological Observations in Bavaria.

The Royal Observatory at Munich, is the central establishment of the system, which includes observations at no less than two hundred and sixty towns and villages, the observers being either members of a meteorological society, formed for the purpose, or persons employed

by the government. Hourly registry is made at the Munich Observatory, of the temperature and pressure of the air, by self registering instruments.

On the Principles of Electro Magnetic Machines.

Professor Jacobi, of St. Petersburg, infers, from his experiments, the following laws in reference to the magnetism developed by the application of the galvanic current.

1. The amount of magnetism produced in malleable iron by a galvanic current is proportional to the force of the current.
2. The thickness of the wire composing a helix, and surrounding an iron rod, is of no consequence, provided the number of turns of the helix, and the force of the current, remain the same. With thin wires, however, a more powerful galvanic battery must be used, in order to overcome the resistance in the conductors.
3. Generally, in practice, the influence of the coil, may be neglected.
4. The total action of the electro-magnetic helix upon the iron rod, or core, is equal to the sum of the effects produced by each coil separately.
5. The maximum of magnetic effect is obtained from a galvanic current, when the total resistance of the conducting wire, which forms the helix, is equal to the total resistance of the battery.
6. When the diameter of the iron cylinder forming the core of the helix is increased, the length remaining the same, the force of magnetism developed by a given current is increased in the same proportion.
7. A variation in the length of the core only influences the result by admitting a greater number of turns of the helix upon it.
8. The attraction of electro-magnets is proportional to the square of the force of the galvanic current, by which they are formed.

In the last trials made in propelling a boat twenty-eight feet long, seven and a half wide, and drawing two feet and three quarters of water, on the Neva, a velocity of three miles an hour was kept up. The boat carried twelve to fourteen persons. Professor Jacobi remarks that this is the velocity attained by the first steamboat.

In reference to the practical application of electro-magnetic power, Professor Jacobi gives the following rules. 1st. The maximum of mechanical effect is proportional to the square of the number of voltaic elements, multiplied by the square of the electro-motive force, and divided by the resistance of the voltaic circuit. The co-efficient by which these values must be multiplied to give the effect, depends upon the quality of the iron forming the electro-magnets, the form and arrangement of the rods, and the distance between their ends. A battery of platinum and zinc plates produces two or three times the effect of a similar one of copper and zinc. 2nd. The force of the machine varying directly as the square of the number of coils in the helix, and the velocity inversely as the same square, the maximum power is independent of this number. It is also independent of the

dimensions of the electro-magnetic rods. 3rd. The attractive force of the electro magnets, or pressure of the machine is proportional to the square of the force of the current. 4th. The economic effect, or the available power divided by the consumption of zinc, is expressed by the relation between the electro-motive force and the co-efficient spoken of under the first head. 5th. The consumption of zinc while the machine is at rest is double that when producing the maximum effect.

Professor JACOBI concludes his remarks thus:—

"I consider that there will not be much difficulty in determining with sufficient precision the duty of one pound of zinc, by its transformation into the sulphate, in the same manner that in the steam engine, the duty of one bushel of coal serves as a measure to estimate the effect of different combinations. The future use and application of electro-magnetic machines appears to me quite certain, especially as the mere trials and vague ideas which have hitherto prevailed in the construction of these machines, have now at length yielded to the precise and definite laws which are conformable to the general laws which nature is accustomed to observe with strictness whenever the question of effects and their causes arise. In viewing, on the other hand, a chemical effect, the intermediate term scarcely presents itself. In the present case, it is magnetic electricity, the admirable discovery of Faraday, which we should consider as the regulating power, or as it may be styled, the logic of electro-magnetic machines."

Progress of Civil Engineering.

Account of Dircks' Patent Improved Metallic Railway Wheels with Wood-faced Tyre, read by MR. HENRY DIRCKS, *before the Mechanical Section of the British Association, at Glasgow, Sept.* 19, 1840. *And also before the Polytechnic Society, at Liverpool, Oct.* 8, 1840.

As an introduction to the observations immediately relating to the improved wheel which is the subject of the present communication, a few preliminary observations may serve to make its nature and advantages more generally understood.

Wooden wheels were originally in common use on railways; these were afterwards superseded by the extensive use of cast iron wheels; and both of these descriptions of wheels were much improved by manufacturing them with wrought iron tyres. Modifications of these wheels are still in use on the Liverpool and Manchester Railway, the wooden wheels having the nave of cast iron, and the spokes and rim of wood, the tyre being of wrought iron. On the London and Birmingham Railway, cast iron wheels are extensively used. On the continent of Europe, and in America, cast iron wheels are seemingly employed by preference; and are no doubt quite as safe for traveling, where great speed is not practised.

In England, a decided preference is given to wrought iron wheels,

in which this metal is used throughout, with the exception of the boss being *cast* around the ends of the spokes. The latest improvement on these has been the making of the entire wheel, including the boss, of wrought iron.

The wheels now in general use derive their chief novelty from the construction and placement of the spokes, with a view to obtain elasticity, strength, and durability. One variety which does not come under this denomination, is the plate wheel, supposed on its introduction to possess some peculiar advantage in overcoming a supposed resistance of the atmosphere. Except, however, in relation to variations in size, the present wheels are little more than varieties in pattern. The common diameter of carriage and waggon wheels is three feet, and the largest driving-wheels for locomotives are those employed on the Great Western Railway, being six or seven feet in diameter,—though at one time they were made as large as ten feet.

The action of an iron wheel on an iron rail, though derived from a rolling motion, can only be compared to a series of blows, and the rebound occasioned by iron striking iron is well known to be considerably greater than is produced by striking wood on iron. To this simple fact we may trace the tremulous motion occasioned by iron wheels on an iron railroad; and when, by any trifling accident, as an inequality from the rising of one end of a rail, or sometimes even from small flinty pebbles getting on the rail, the rebound is not more fearful than dangerous. The tremulous motion of the rail just adverted to renders it necessary in most cases to lay the rails on wooden sleepers. As an illustration of what is meant, it may be mentioned that on the Dublin and Kingstown Railway the rails were originally laid on granite sleepers, but the tremor was so great as to loosen the rails, and occasion serious fears from the consequent damage sustained by engines and carriages passing along the line. It was, therefore, ultimately agreed to take up the granite and lay down longitudinal wooden sleepers, a work of considerable labour and expense. In some cases the nature of the soil or sub-soil may allow the use of stone blocks; and where they can be applied with safety, they are preferred, for the reason that a road laid on *stone* blocks can be kept up at a lower rate than one laid on *wooden* sleepers; and, as has been endeavoured to be clearly shown, the only reason for laying the stone aside, arises from the tremor imparted to the rail by iron wheels as at present used.

We shall now proceed to a description of the improved metallic wheel with wood-faced tyre, showing its advantages in connexion with the preceding observations. The construction of the wheel may be understood by imagining a spoked wheel with a deep channelled tyre. The wheel may be made either of cast or wrought iron, it having been ascertained that tyre bars can be rolled to the required pattern. In this channelled tyre are inserted blocks of African oak, measuring about four inches by three and a half inches, solidified by filling the pores with unctuous preparations; thereby counteracting the effects of wet by capillary attraction,—to which, by this means, it becomes impervious, and at the same time is not liable to unequal con-

traction and expansion. The blocks of wood are cut to the requisite form to fit very exactly in the external circular channel of the wheel, with the grain placed vertically throughout, forming a complete facing of wood. There are about from twenty-eight to thirty of these blocks round each wheel, where they are retained in their place by one or two bolts passing through each, the two sides of the channel having corresponding holes drilled through them for this purpose: the bolts are then well rivetted. After being so fitted, the wheel is turned in the usual manner. The wheel when finished has all the appearance of a common railway wheel, but with a rather deeper rim, the tyre faced with wood, and the flange of iron. Woods of various qualities may be used, whether hard or soft, requiring different chemical preparations according to their porosity, and in some instances requiring to be compressed.

The several advantages which this wheel possesses, are—

1. That the wood facing will wear a considerable time without requiring any repair.

2. That the wood can be re-faced, by turning it up again in the lathe, as practised with worn iron tyres.

3. That the tyre can be re-faced with wood at little expense, and at a far less loss of time than usual. In the operations of re-facing these wheels, or putting in new wood, the work can be performed without the labour and cost of removing the wheels from the axles, which in the keying and unkeying is known to be very troublesome.*

4. That, in regard to their working, it is the opinion of practical engineers, confirmed by actual experiment, that they will work smoother, easier, and, as some have expressed it, more "sweetly" than iron-tyred wheels; with the advantage of going well in wet weather, even upon inclines,—having sufficient adhesion to the rail, without dropping sand to assist them in this respect, as practised when iron wheels are used.

5. That another and very important result will be, that the rails themselves will suffer less wear by using this kind of wheel, and that the fastenings, sleepers, and blocks will receive considerably less injury, and thereby favour the laying of railroads on stone blocks, wherever they are considered to be most desirable.†

A metallic wheel with a wood-faced tyre, which is the principle of this construction, obviates most, if not all, the difficulties which have been experienced, whether in the use of wooden, cast iron, or even wrought iron wheels. Cast iron wheels may, indeed, now be considered not far short of being equal to wrought iron wheels, for safety and durability, with all the superiority of which the application is susceptible. They are also neither clumsy nor inelegant in form, and are capable of being made to any pattern, even for carriage wheels for common roads. It may, therefore, very possibly occur that they

* As in every thing affecting railways, it is a desideratum to decrease the expenses as much as possible, it may here he mentioned that three feet cast iron wheels, with wood-faced tyres and wrought iron axles complete, can be made much cheaper than the generality of wheels.

† On lines situated like the Greenwich Railway and the Blackwall Railway, wood-faced wheels would diminish much of the noise which at pesent is a source of general complaint.

will have the effect to bring cast iron wheels into as general use and as much reputation here as on the continent. This new construction and simple adoption of wood makes excellent driving wheels for locomotives; it may be readily stopped by using a cast iron brake, and does not undergo that wear which might be expected from the friction it then has on the rail. The wood, by use, becomes exceedingly close and firm, acquiring a surface not easily distinguishable from metal in appearance. Civ. Eng. & Arch. Jour.

On the best method of Ventilating Coal Mines.

When two shafts, or pits, are sunk down to a coal mine, and a road cut through the mine from one to the other, the air that fills this road becomes rarified from the heat of the coal and the minerals surrounding—consequently, ascends one of the shafts, just like a chip of wood when immersed in water, and from the same cause—the shaft that is least in depth being that which the air generally ascends, from an obvious reason. Thus we have a process of ventilation going on, so long as the materials at the bottom remain at a greater degree of heat than the air at the surface of the earth—which current of air is more rapid the colder the air is at the surface (a well known fact amongst miners, that the current of air is greater in winter than summer;) the fire damp, or hydrogen gas, that issues out of the fissures of the coal, or minerals either above or below the coal, gets mixed with the agi tated air, and is carried up the shaft as fast as it evacuates itself, leaving the road between the shafts clear and safe. This is the principle on which ventilation is built. A fire placed at the bottom of one of these shafts would heat the surrounding materials also a considerable way up the shaft, and, as the air passed, part of it would be consumed by the fire; the other, and by far the greatest part, would become rarified by passing the fire and heated materials, and so ascend rapidly up the shaft—at the same time the surrounding air would rush down the other shaft to supply its place. Thus, a fire placed at the bottom of one of the shafts is only a more powerful substitute for the natural process; it is also evident, that the bottom of the shaft is the most proper place to put a fire—and those who doubt this have only to make the experiment to be convinced.

Having thus got a current of fresh air, we have only to direct its course through the various workings to carry away the gases as they evacuate themselves; but before I describe any method for doing this, let me show how the shafts are got down, also how the road is cut between them, which is generally a troublesome piece of work to manage. Shafts may sometimes be sunk to a considerable depth without experiencing any difficulty or danger from the damps or gases, but, when these present themselves, recourse must be had to some method for removing them away. The general way in this part of the country is to partition a small segment of the shaft off by means of boards, or, otherwise, to introduce pipes made of boards, of a foot by sixteen inches aperture, down the shaft, carrying the partition or

pipes along with them as they proceed in sinking, till they reach the mine; this partition, or the uppermost pipe, when pipes are used, is bent at the top, and carried in an horizontal direction to a little distance from the mouth of the shaft, where a chimney is erected, and a fire kindled at the bottom of it, similar to that mentioned by Mr. "X.," which causes a current of air to descend down the shaft and up the partition, or pipes, to the fire, then up the chimney, carrying away the damps or gases, as before described. Now, having a double road down the shaft for the ingress and egress of the air, answering for a time as two shafts, the cutting of the air or wind-road is then commenced. This road is cut double—that is, two roads are cut at the distance of about six feet from each other, and every three or four yards a cross-way is cut through between them—the pillar or coal left between them serving as a partition—the air coming down the shaft up one of these roads, turning through the opening or cross-way between them, then down the other road and up the partition, or pipes, to the fire. In this way the work proceeds till it reaches the other shaft, the miners always building one opening up as soon as they have cut another through. I may here remark, that while they are cutting the three or four yards, also the opening between, they are obliged either to let their candles remain at a distance behind them, or, otherwise, use the Davy lamp—the Davy lamp is generally used on this occasion.

The method of working coal mines are various, depending on the nature of the mines themselves, but more especially on the roof; there are, however, three essential points to be aimed at, the accomplishing of which depends on the skill of the manager. First—he must aim at getting as much of the mine out as possible, at the least expense, without injuring the workmen. Second—at keeping a good road free from wet and dirt, for the conveyance of the coals from all parts of the workings to the shaft. Third—at the greatest safety to the miners, from the roof and other things, but more especially from the damps or gases. He who has accomplished these deserves the name of manager. It may be thus conceived, that as the mines, and especially the roofs, vary, the methods of working and ventilating them must vary also—but all methods that have fallen under my observation bear some analogy to one another. By driving the roads double, as before described, the wagon roads may be cut with safety; but when the open, or wide working, as it is called, is commenced, it is then a little different—but these kind of workings should be so conducted as to have a current of air passing through them. Mining Jour.

Description of the Nonsuch Iron Passage Boat plying on the Limerick navigation, between that place and Killaloe. By Charles Wye Williams.

The attention of Mr. Williams having been attracted to the successful plan for the conveyance of passengers adopted on the Glasgow and Paisley Canal, where light sheet iron boats of great length travel

at a speed of nine miles an hour, he was induced to attempt the introduction of the same system on the Irish canals. A great difficulty, however, presented itself, as the locks there would only admit boats sixty feet long, which length was quite inadequate to the carrying out with advantage the principle involved in the long light Scotch boat. To overcome this difficulty, he constructed a sheet iron boat, eighty feet long, and six feet six inches wide at midships, having stem and stern ends (each ten feet long) attached by strong hinges to the body, and susceptible of being rapidly raised to a vertical position by means of winches; thus reducing the length to sixty feet when required to pass through a lock. It is evident that by this means there would be gained not merely the apparent additional buoyancy of ten feet at each end of the boat, which from the form would not be very effective, but in reality the buoyancy due to an addition of twenty feet of the midship section. The boat thus constructed has been found to answer perfectly; the buoyancy is equal to that of the Scotch boats of similar dimensions; no crankness or unsteadiness accrues when the ends are raised; it is capable of carrying sixty passengers, traveling at a speed of nine miles per hour, with the same power that was required to draw a sixty feet boat with a less load, and there is a much less action on the canal bank in consequence of the increased length, which at the same time imparts stiffness, and enables passengers to enter and leave the boat with safety. Considerable time is saved in passing the locks, by the opposition of the square end when the bow is raised; the boat may thus be run almost at full speed into the lock, and both ends being raised simultaneously, it is stopped much more easily than if the tapered ends were down. No provision is necessary for keeping the ends down, as the weight of the bow and steersman answers the purpose. This boat has been working without intermission for three years between Limerick and Killaloe, traversing twice daily a distance of fifteen miles, on a navigation of considerable intricacy, and passing eleven locks, without any accident having hitherto occurred.

Athenæum.

Mechanics' Register.

Accidents on Railways.

To the list we gave last week of railways, the miles run, and accidents which have occurred, we have to add the returns of the following:—

The Great Western has run 29,200,000 miles, carried 1,520,000 passengers, without any accident, fatal or otherwise, to a passenger, from its opening, 2 years and three months.

The Brandling Junction has run 92,876 miles, and carried 617,000 passengers without any fatal, and only two trifling accidents, neither of which prevented the parties from going about their usual business, in 12 months, to the 5th instant.

The Bolton and Leigh has run 223,480 miles; carried 674,870 passengers in 9¼ years, to the 15th September, with the following acci-

dents:—one passenger, attempting to get into the train when it was starting, got his foot bruised; another, who had got upon a wagon going off with the train, was thrown off and had his arm injured; a third had a slight contusion occasioned by a collision; and a fourth was killed by jumping off a train going at full speed, in consequence, as it was believed, of his being intoxicated. The only accidents attributable to the Railway are obviously the "slight contusion," and the injured arm.

The Dundee and Arbroath, opened October the 8th, 1838, (now 23 months) has, to the 1st September inst., carried 378,043 passengers, (the miles run not stated) with the following solitary accident, namely, the breaking of the leg of a passenger who had, contrary to the regulations, got into the luggage wagon.

The Arbroath and Forfar was opened January the 3rd, 1839, (now 20 months) and has run 59,000 miles, and carried 175,000 passengers, to September 10th. One accident only has happened; that is, a passenger broke his leg by jumping off the train while in motion.

Thus are added to our former list, from these five railways, only one of which is a large passenger line, 3,365,000 passengers carried, and on four only of the lines 29,575,000 miles run, without one fatal accident, and only two slight bruises fairly attributable to the Railways; for we repudiate all accidents which the drunken or headstrong ways of men, violating orders and rules, bring upon themselves. The account, therefore, will stand thus; about 256 millions of miles have been run, and 14 millions of persons carried, with only two fatal accidents from the railway system. Railway Mag.

Comparative Longevity of Miners.

The average age of those miners who died in Illogan, was forty-nine, and of those not miners, sixty-eight—making a difference of nineteen years. In Gamborne, the longevity of the miner was fifty-four years, whilst that of the man not employed in mines, was sixty—showing only a difference of six years. On this he should have to remark presently. The average of Gwennap was, of the miner, forty-six years, and of the non-miner sixty years—exhibiting a difference of fourteen years. But there was one other important fact, and to that he begged to direct the attention of the philanthropist. A mean per centage of seventeen of their mining population came to violent deaths in consequence of their employment. In Gwennap the deaths were one-sixth, but in Illogan he found it increase to 32 per cent.—so that it appeared that of the miners buried in Illogan, one-third had been the subjects of coroners' inquests. Mining Jour.

Early Settlement of America by Eyropeans.

A highly interesting discovery has been announced by the Danish geologist, Dr. Lund, to the Northern Archaiological Society, as made by him, while excavating in the neighbourhood of Bahia, in Brazil. This discovery began with the fragment of a flag stone, covered with

engraved Runic characters, but greatly injured. Having succeeded in decyphering several words, which he recognized as belonging to the Icelandish tongue, he extended his researches, and soon came upon the foundations of houses in hewn stone, bearing a strong architectural resemblance to the ruins existing in the northern parts of Norway, in Iceland, and in Greenland. Thus encouraged, he went resolutely on, and at length, after several days' digging, found the Scandinavian God of Thunder, Thor, with all his attributes—the hammer, gauntlets, and magic girdle. The Society has commissioned Professor Rafn, who first established, in an authentic manner, the existence of ancient relations between Iceland and Northern America, (anterior to the discovery of that part of the world by Columbus) to report on the subject of Dr. Lund's letter, and to publish his report, with a view to direct the attention of the learned to this very interesting discovery, which would seem to prove, that the ancients of the North had not only extended their marine voyages to Southern America, but even formed permanent establishment in that country.

Athenæum.

Improved Mode of Applying Water-power, patented by Captain George Davey.

The inventor claims the application of air jackets or chambers to a column of water, and the method of applying the power obtained by the pressure of the said column of water, through the medium of the compressed air contained in the said air jacket, whereby so great a quantity of air is driven into the working cylinder as to effect a great saving of water, which, in cases requiring a reservoir at a high level, is very important. An upright tube leads from the reservoir to the full extent of the fall of water; at each thirty feet this tube is surrounded by an air jacket, and three or four fine holes are made at the bottom of the tube, within the space covered by it. The lower part of the tube has a lateral connection with a small cylinder, with a double piston or dead boxes working therein. At the opposite side of this cylinder, there is a lateral connection with the working cylinder, that moves, by its piston and rod, the pump or engine. The water, passing from the reservoir, down the tube, forces a quantity of air from the air jackets, with the water, through the small cylinder (that has its double piston open) into the large working cylinder, by which means the piston of this cylinder is forced up; and the tappets on the rod of this piston are so arranged as to strike a lever connected with the rod of the double piston, which admits and shuts off the supply of water from the tube to the working cylinder. The piston of this cylinder being now forced up, the tappet on the rod causes the lever to put the double piston in such a position as to cut off the supply of water, until the water that is below the large working cylinder flows out into the waste, or discharging level. The piston with the rod, in descending, by its gravity, causes another tappet to strike the lever, and put the double piston or dead boxes, in the first position, in order to receive a fresh supply of compressed air and water, to set

the piston in the large cylinder again in motion, which communicates its power to a pump or engine. Civ. Eng. & Arch. Jour.

An Improved Apparatus for Regulating the Supply of Water to Steam-boilers, patented by JAMES KNOWLES, *Little Bolton, Lancaster.*

Claims the use of a self-acting apparatus, the working parts of which are within the boiler, and communicate to the supply valve from without. A lever or rod is placed longitudinally on a fulcrum within the boiler, the longer end of which is an upright rod, with a float attached thereon, passing to the outside of the boiler; at the shorter end of the lever is another upright rod connected with the supply valve, working in a tube. As long as there is plenty of water in the boiler, the float will continue to press up the long end of the lever, and, consequently, cause the valve on the upright rod of the short end of the lever to press down on its bearing, and prevent the admission of water from the tank. But when the height of the water in the boiler diminishes, the float lowers with it, and thereby forces up the rod with the valve; thus admitting a further supply of water until the float again rises to close down the valve.—*Inventor's Advocate.*

Ibid.

Meteorological Observations for December, 1840.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	28	34	29 65	30 10	W.	Moderate.		Cloudy—clear.
☾	2	22	38	30.25	.25	S.E S. W	do.		Clear—do —do.
	3	29	44	.15	.15	W.	do.		Partially—do.—do.—do.
	4	27	28	.32	.35	N E.	do.		Cloudy—do.
	5	20	25	.16	.12	W.E.	do.	.63	Snow—cloudy,
	6	20	26	29.91	29 86	N.N.E.	Brisk.	1.05	Snow—do.
	7	19	29	30 07	30.12	N.W W.	Calm.		Clear—do.
☉	8	16	32	13	00	S W.	do.		Clear—cloudy.
	9	28	34	29.95	29.88	S. W.	do.		Clear—partially cloudy.
	10	33	46	.78	.75	W.N.W.	do.		Cloudy—clear.
	11	29	40	30.04	30 06	W.	do.		Clear—do.
	12	26	42	.10	.00	E.	do.	.78	Clear—rain.
	13	40	45	29.50	29.50	W.	Moderate.		Cloudy—clear.
	14	32	43	.60	.60	W.	do.		Clear—do.
☽	15	29	46	.60	.60	W.	do.		Hazy—do.
	16	38	34	.56	.56	W.N.	do.	.45	Lightly cloudy—snow.
	17	26	32	.60	.65	W.	do.		Clear—flying clouds.
	18	22	24	.80	.83	W.	Brisk.		Partially cloudy--do.—do.
	19	16	26	.95	30 00	W.	Moderate.		Clear—do.
	20	15	28	30.04	.10	W.	do.	.30	Clear—shower.
	21	21	30	.00	.02	W.	Brisk.		Clear—do.
	22	30	38	29 75	29.58	W.	do.		Cloudy—do.
⊗	23	20	28	30.01	30 00	W.	Moderate.		Clear—do.
	24	29	35	29.74	29.74	W.	do.		Cloudy—partially cloudy.
	25	12	22	.96	.96	W.	do.		Clear—do.
	26	24	38	.60	.50	E.	Calm.	.35	Snow—cloudy.
	27	28	24	.46	.46	W.	Moderate.		Cloudy—do.
	28	19	29	.85	.95	W.	do.		Clear—do.
	29	21	36	30.00	30.00	W.S.W.	do.		Cloudy—lightly do.
	30	31	38	.00	00	W.	do.		Cloudy—do.
☾	31	33	41	29 94	29.94	E.W.	do.		Cloudy—lightly do.
	Mean	25.35	34.06	29.87	29.89			3.58	

	Thermometer.	Barometer.
Maximum height during the month.	46.00 on 10th and 15th.	30.35 on the 4th.
Minimum " "	12.00 on the 25th.	29.46 " 24th.
Mean	29.705	29.88

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

MARCH, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM THIS JOURNAL VOL. X., 2ND SERIES, P. 371.]

PART SECOND.

In continuation of their report the committee on water power proceed to give deductions from the experiments, the particulars of which have been already stated. As a convenient division of the subject the experiments will be discussed under the heads of I. Overshot Wheels; II. Undershot Wheels; III. Breast Wheels, and IV. General Inferences pertaining to the different modes of using water. To give authority to the conclusions of the committee the examination of the experiments will be minute, but for the benefit of those who wish rather to apply the results than to scan them closely, the third part of the report will contain rules founded on the general conclusions, and applicable directly to the questions occurring in the use of water as a moving power.

I. Overshot Wheels.

1. *The ratio of effect to power.*—It is important in determining the ratio of effect to power, under different circumstances, to employ all the experiments which the tables afford; on this account, as the results for wheel No. 1, when used as an overshot, were obtained with three different forms of gate, it will be necessary to show first that these forms were of equal, or nearly equal, efficiency. This will be done in the following tables, from one to five inclusive. In these tables the velocity of the wheel will be also entered for subsequent use and comparison.

The maximum result under each head is given in tables first, second, and third, as collected from tables A, B, and C., vol. viii, pp. 85, 88, 89.

The numbers in the first column refer to those of the experiments in column 1 of the general tables. The second column contains the head above the bottom of the gate, from 2 of the general tables. The third contains the head and fall, from 13. The fourth, the width of aperture, from 5. The fifth, the velocity of the wheel, from 11. The sixth, the ratio of effect to power, from 17. The next three columns, of tables first and third, contain, severally, remarks from the detailed tables, the mean ratio deduced from the sixth column, and the mean velocity of the wheel from the fifth. The column of remarks is not needed in the second table.

TABLE FIRST.

For the comparison of gate a with gates b and c. Collected from table A. (Vol. viii. p. 85.)

No. of Experiment.	Head above gate. feet.	Head and fall. feet.	Aperture. inches.	Velocity of wheel. feet.	Ratio of effect to power.	Remarks.	Mean velocity of wheel. feet.	Mean ratio of effect to power.
5	2.75	23.00	0.50	5.28	.829			
11	"	"	1.00	5.43	.839			
14	"	"	1.25	5.58	.834		5.43	.834
18	2.25	22.50	0.75	5.21	.820			
23	"	"	1.00	6.01	.835			
31	"	"	1.25	5.50	.837	Last experiment	5.57	.831
33	1.25	21.50	0.50	4.65	.839			
37	"	"	0.75	4.77	.850			
40	"	"	1.00	5.28	.850			
45	"	"	1.25	4.83	.845	Last experiment	4.88	.846
50	0.50	20.75	1.25	4.44	.872		4.44	.872
54	0.25	20.50	0.75	3.99	.810	Water too low		
56	"	"	1.00	3.76	.828	to fill aperture	3.87	.819

TABLE SECOND.

For the comparison of gates b with gate a and c. Collected from table B. (Vol. viii. p. 88.)

No. of experiment.	Head above gate. feet.	Head and fall. feet.	Aperture. inches.	Velocity of wheel. feet.	Ratio of effect to power.	Mean velocity of wheel. feet.	Mean ratio of effect to power.
3	2.75	23.00	0.75	7.52	.838		
8	"	"	1.00	7.66	.832	7.59	.835
15	1.25	21.50	1.00	5.28	.839	5.28	.839
18	0.75	21.00	1.25	5.50	.836	5.50	.836
22	0.50	20.75	1.25	4.65	.832	4.65	.832

TABLE THIRD.

For the comparison of gate c with gates a and b. Collected from table C. (Vol. viii. p. 89.)

No. of experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Remarks.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet			feet.	
2	2.75	23.00	1.00	5.35	.814			
18	"	"	"	6.62	.809	Air vents open.	5.99	.811
5	1.25	21.50	1.25	6.20	.845			
8	"	"	1.50	6.10	.838		6.15	.842
11	0.75	21.00	1.25	4.77	.842			
13	"	"	1.50	5.07	.841		4.92	.841
16	0.50	20.75	1.50	4.60	.831	Water too low to fill buckets.	4.60	.831

The following table contains the averages drawn from the three foregoing tables. In deducing the ratios of the mean velocities of the wheel, the least velocity in the table is taken as unity; and in comparing the mean ratios of effect to power the least ratio is also assumed as unity. The results with those heads only, which occur in all the three cases, are brought into comparison.

TABLE FOURTH.

Comparison of gates a, b, and c. Collected from tables First, Second, and Third.

	Nos. of experiments.	Head above gate.	Velocity of wheel.	Mean velocity of wheel.	Ratio of velos. calling 4.44 unity.	Ratio of effect to power.	Mean ratio of effect to power.	Compar'n of ratios calling .811 unity.
		feet.	feet.	feet.				
Table first, gate *a*.	5, 11, 14	2.75	5.43			.834		
	33,37,40,45	1.25	4.88			.846		
	50	0.50	4.44	4.92	1.11	.872	.851	1.05
Table second, gate *b*.	3 & 8	2.75	7.59			.835		
	15	1.25	5.28			.839		
	22	0.50	4.65	5.84	1.31	.832	.835	1.03
Table third, gate *c*.	2 & 18	2.75	5.99			.811		
	5 & 8	1.25	6.15			.842		
	16	0.50	4.60	5.58	1.26	.831	.828	1.02

It appears from this comparison that the ratio of effect to power with the different gates, varies within the moderate limits of less than three per cent, being very little in favour of gate *a*. In fact the results are almost identical. This is not the case with the velocities, the consideration of which cannot, however, be conveniently introduced in this place.

The foregoing comparisons having been made with different widths of aperture, that is by taking a mean under each head, disregarding the variation in the quantity of water, they may be objected to as deduced from experiments not alike in every respect; for if the variation in the quantity of water produces any effect, these averages will be unequally altered by it. This reasoning is not applicable to any considerable degree, because the variation in the ratio of effect to power from the cause stated is small. To prove this position and to show the accordance of these mean results with single ones which are strictly alike in all the circumstances, the following table has been selected from tables first, second, and third. The arrangement of it is sufficiently explained by the headings of the different columns.

TABLE FIFTH.

Comparison of experiments similar in circumstances with gates a, b, and c.

Head above gate in feet.	Head and fall, in feet.	Width of aperture, in inches.	Gate *a*.		Gate *b*.		Gate *c*.		Ratio of velocities 4.44 being unity.			Ratios .814 unity.		
			Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Gate *a*.	Gate *b*.	Gate *c*.	Gate *a*.	Gate *b*.	Gate *c*.
2.75	23.00	1.00	5.43	.839	7.66	.832	5.35	.814	1.22	1.73	1.20	1.03	1.02	1.00
1.25	21.50	1.00	5.28	.850	5.28	.839			1.19	1.19		1.04	1.03	
"	"	1.25	4.83	.845			6.20	.845	1.09		1.40	1.04		1.04
0.75	21.00	1.25			5.50	.836	4.77	.842		1.24	1.08		1.03	1.03
0.50	20.75	1.25	4.44	.872	4.65	.832			1.00	1.05		1.07	1.02	
							Mean		1.12	1.30	1.23	1.04	1.02	1.02

In these single results the ratios range from 1.00 to 1.07, the averages being almost exactly in accordance with the former conclusions. It follows, then, that *as far as regards the ratio of effect to power, gates a, b, and c, may be used in practice at the convenience of the mill-wright.*

We are now prepared to determine the mean ratio of effect to power in overshot wheel No. 1, twenty feet in diameter. This is done in the following table taken from tables first, second, and third, where the ratios under the different heads, with the three gates, are collected, and the means deduced.

TABLE SIXTH.

Overshot wheel No. 1.—Ratios of effect to power under different heads.—The power being calculated on the head and fall.

Head.	Mean ratio of effect to power, with gate			Mean.
	a.	*b.*	*c.*	
Feet.	Ratio.	Ratio.	Ratio.	Ratio.
2.75	.834	.835	.811	.823
2.25	.831			.831
1.25	.846	.839	.842	.842
0.75		.836	.841	.838
0.50	.872	.832	.831	.845
0.25	.819			

Omitting the last result in which the water was so low as to pass irregularly over the gate, the ratios vary from .823 to .845, or from 1 to 1.025. But two and a half per cent. of effect would, therefore, be lost in an overshot wheel of this size by varying the head from six inches to two feet nine inches. The lower heads give, of course, the best ratios, and leaving out of consideration the velocity of the wheel, are most advantageous.

The high results which these experiments prove may be obtained in practice from large overshot wheels, are worthy of special notice. With a head of .11 of the whole head and fall, (three inches in twenty-seven), which was the lowest used by Smeaton in his experiments, he obtained an effect of but .69 of the power. While in the experiments of the Committee with heads of 2.25 feet, for a head and fall of 22.50 feet, (.10 of the head and fall) and of 2.75 feet for 23.00, (.12 of the head and fall) we have ratios of .823 and .831.

It follows from these experiments that *in running a large overshot wheel to the best advantage, eighty-four per cent. of the power may be calculated upon for the effect.*

In regard to the effect of the quantity of water passing into the buckets of an overshot wheel with a given velocity, it is reasonable to conclude that under determinate circumstances it admits of being adjusted so as to produce a maximum effect. The annexed table will

show that in fact this is the case. It is selected from tables first and third, and contains the ratio of effect to power under given heads and openings.

TABLE SEVENTH.

Change of ratio by varying the quantity of water admitted to the buckets of wheel No. 1, overshot.

Width of aperture, in inches.	Ratio under head, in feet, of 2.75	2.25	1.25	1.25	0.75	Mean.
0.50	.829		.839			.834
0.75		.820	.850			.835
1.00	.839	.835	.850			.841
1.25	.834	.837	.845	.845	.842	.841
1.50				.838	.841	.839

The tendency to a maximum as the quantities are increased, by increasing the widths of the apertures, is not only seen in the separate columns but appears in the average, where it might be supposed that the introduction of the experiments with low heads would tend to raise the numbers so much as to make the small variation by quantity disappear.

The amount of increase, however, is shown to be too small to be regarded in practice, being probably less than one per cent. It may therefore be assumed *that within the limits of regular motion in the wheel, and waste from unduly filling the buckets, no diminution of effect will be experienced.*

In these experiments the areas of discharge for the water were varied from eight to twenty-four square inches, and the portion of the bucket which contained water to the whole capacity, in the case of the greatest proportion, was three tenths to one.

2. *The velocity of the wheel.*—The first question to be examined in this division of the subject is in reference to the relative velocities of the water and of the wheel, when the ratio of effect to power is a maximum. To determine which, the velocities of the water in the cases of maximum ratio given by the tables must be first ascertained. The velocity of efflux from the aperture in any particular case will be found by comparing the number of pounds of water discharged with the duration of the experiment. The discharge per second being thus known, in pounds, is converted into cubic feet and divided by the area of the aperture in square feet. In this way the numbers contained in in the third, eighth, and thirteenth columns of the annexed table, have

been found. For subsequent reference, a comparison has been made in this table of the theoretical discharges with those actually measured.

TABLE EIGHTH.

Quantities of water discharged per second, under the several heads, and with the gates *a*, *b*, and *c*, deduced from experiments giving the maximum ratio of effect to power. Collected from tables A, B, and C.

Overshot No. I.

Gate *a*.					Gate *b*.					Gate *c*.				
Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.
feet.	in's.	feet.			feet.	in's.	feet.			feet.	in's.	feet.		
2.75	0.50	7.91	0.59		2.75	0.75	12.50	0.94		2.75	1.00	9.60	0.72	
"	1·00	7.23	0.54			1.00	12.20	0.92						
"	1.25	7.52	0.57	0.57					0.93					0.72
2.25	0.75	7.18	0.60											
"	1.00	7.15	0.59											
"	1.25	7.16	0.59	0.59										
1.25	0.50	6.53	0.73		1.25	1.00	8.00	0.89	0.89	1.25	1.25	6.57	0.73	0.73
"	0.75	5.51	0.61								1.50	6.57	0.73	
"	1.00	5.04	0.61		0.75	1.25	5.62	0.81	0.81	0.75	1.25	5.19	0.75	0.73
"	1.25	5.45	0.61	0.64							1.50	4.93	0.71	
0.50	1.25	4.06	0.72	0.72	0.50	1.25	4.48	0.79	0.79	0.50	1.50	3.99	0.70	0.70
0.25	0.75	3.54	0.88											
"	1.00	3.16	0.78	0.83										
Mean of 2.75,2.25,0.50,				0.63			Mean		0.85			Mean		0.72

A comparison of the quantities actually discharged with the theoretical discharges, shows a difficulty in obtaining the actual velocity of the efflux. The coefficient for the contraction of the vein by gate *a*, is very nearly that for a thin plate, while those for *b* and *c* show that they have acted in part as adjutages in modifying the discharge, although it is a fact that experiments made when the aperture was evidently filled were rejected. While the quantity of discharge is thus increased, the velocity of efflux is actually diminished. If then the impulse of the water and not the quantity delivered is the determining circumstance of the velocity of the wheel, and the retardation of the water should be considerable, the fact will appear in the sequel.

After leaving the aperture, the water is accelerated in falling until it strikes the wheel. To know where to assume the average point of impact it will be necessary to consider the motion of the wheel. The

water on entering an elbow bucket will first strike against the arm, then as the wheel revolves will meet the bottom of the bucket, or soling of the wheel, and so on until the next bucket present itself. After the water has struck the arm of the bucket it falls to the bottom, not having imparted all its velocity to the wheel by the impact. As the bucket fills, the distance through which the water falls will diminish.

The following approximate table has been calculated from the actual quantities of discharge per second under the different heads, and with different apertures, the known velocity and particular construction of this wheel.

TABLE NINTH.

Showing the relative proportions of the part of each bucket, which contained water, to the whole capacity of the bucket.

	Head.	Width of aperture.	Discharge per second.	Velocity of wheel per second	Time of passage of bucket.	Water received by bucket.	Portion of entire bucket w'h. is filled.	Mean ratio.
	feet.	inches.	cubic feet.	feet.	seconds.	cubic feet.	Ratio.	
Gate a, elbow buckets.	2.75	0.50	0.438	5.28	0.24	0.105	0.14	
	"	1.00	0.800	5.43	0.23	0.184	0.25	
	"	1.25	1.040	5.58	0.22	0.229	0.31	0.23
	2.25	0.75	0.597	5.21	0.24	0.143	0.19	
	"	1.00	0.794	6.01	0.21	0.167	0.23	
	"	1.25	0.991	5.50	0.23	0.228	0.31	0.24
	1.25	0.50	0.362	4.65	0.27	0.097	0.13	
	"	0.75	0.458	4.77	0.26	0.119	0.16	
	"	1.00	0.611	5.28	0.24	0.146	0.20	
	"	1.25	0.755	4.83	0.26	0.196	0.27	0.19
	0.50	1.25	0.564	4.44	0.28	0.158	0.22	0.22
	0.25	0.75	0.294	3.99	0.31	0.091	0.12	
	"	1.00	0.350	3.76	0.33	0.115	0.16	0.14
Gate b, elbow buckets.	2.75	0.75	1.040	7.52	0.16	0.166	0.23	
	"	1.00	1.360	7.66	0.16	0.218	0.30	0.26
	1.25	1.00	0.887	5.28	0.24	0.213	0.29	0.29
	0.75	1.25	0.777	5.50	0.23	0.179	0.24	0.24
	0.50	1.25	0.619	4.65	0.27	0.167	0.23	0.23
Gate c, elbow buckets.	2.75	1.00	1.088	6.85	0.18	0.196	0.27	
	"	1.25	1.320	6.62	0.19	0.251	0.34	0.30
	1.25	1.25	0.870	5.66	0.22	0.191	0.26	0.26
	0.75	1.50	0.856	5.66	0.22	0.188	0.26	0.26
	0.50	1.50	0.667	4.65	0.27	0.180	0.25	
	"	2.00	0.736	5.21	0.24	0.176	0.24	0.24
Gate c, centre buckets.	2.75	1.00	1.073	5.35	0.23	0.247	0.34	0.34
	1.25	1.25	0.909	6.20	0.20	0.182	0.25	
	"	1.50	1.090	6.10	0.20	0.218	0.30	0.27
	0.75	1.25	0.717	4.77	0.26	0.186	0.25	
	"	1.50	0.818	5.07	0.25	0.204	0.28	0.26
	0.50	1.50	0.661	4.60	0.27	0.178	0.24	0.24

From this table it appears that at the higher heads, 2.75 and 2.25 feet, the portion of the elbow buckets which was filled was .25 and at low heads .17. From these data it may be shown that if the water

were distributed with a surface parallel to the soling, the depth in the first case would have been .11 of a foot, and in the second .07. The water flowing towards the lower part of the bucket, ever occupied an average depth equal to that calculated, and the depth of the bucket being .60 ft., no sensible error will arise by taking .15 ft. from the distance between the aperture and the bottom of the bucket, in the higher heads, and .10 ft. in the lower ones to obtain the distance through which the water was accelerated after leaving the aperture.*

The same table shows that the elbow buckets used by the committee had a sufficient breadth of throat to receive the water without difficulty. The portion of the centre buckets occupied being, at a mean, very little greater than that of the elbow buckets.

In the table which follows, the approximation just referred to is applied. The head corresponding in theory, to the velocity of efflux from the aperture or virtual head, is first obtained. To this is added, for the higher heads, the distance from the aperture to the bottom of the bucket, obtained from tables A, B, or C, less .15, and for the lower the same distance less .10 ft. The velocity corresponding to the sum is that with which the water struck the wheel. The velocity of the wheel at the maximum is transferred from the tables first, second, and third.

TABLE TENTH.

Comparison of the velocity with which the water strikes the wheel with the velocity of the wheel.

Overshot No. I.

	Head.	Velocity of Water.	Virtual head.	Virtual head tog'th'r with constant.	Velocity of impact.	Velocity of wheel.	Ratios.	Mean ratio.
	feet.	feet.	feet.	feet.	feet.	feet.		
Gate *a*.	2.75	7.55	0.885	1.585	10.02	5.43	0.54	
	2.25	7.17	0.798	1.498	9.78	5.57	0.57	
	1.25	5.50	0.469	1.219	8.74	4.88	0.56	
	0.50	4.06	0.256	1.006	8.02	4.44	0.55	
	0.25	3.35	0.176	0.924	7.69	3.87	0.50	0.54
Gate *b*.	2.75	12.35	2.368	3.068	14.03	7.59	0.54	
	1.25	8.00	0.978	1.728	10.50	5.22	0.50	
	0.75	5.62	0.490	1.240	8.90	5.50	0.62	
	0.50	4.48	0.311	1.061	8.26	4.65	0.56	0.55
Gate *c*.	2.75	9.60	1.431	2.131	11.71	5.35	0.46	
	1.25	6.57	0.670	1.420	9.54	6.15	0.64	
	0.75	5.06	0.397	1.167	8.66	4.92	0.57	
	0.50	3.99	0.247	0.997	7.98	4.60	0.57	0.56

* This correction is not important, but as the calculations pertaining to it serve to show an important fact in regard to the due proportions of the buckets, it has been deemed worth while to produce them, and to show their application. The ratio of the velocity of the wheel to that of the water would be affected but .02 in .52, by assuming the bottom of the bucket as the place of impact.

The table just given developes this fact in regard to *the velocity of the overshot wheel,* namely, that it *bears a constant ratio, for maximum effects, to that of the water, this ratio being at a mean about .55, or nine-sixteenths.*

The ratios for both gates *b* and *c*, exceeding that for *a*, confirms, in a degree, the remark before made, that the velocity is checked in flowing from them.

The correspondence just shown, renders the determination of the head for an overshot wheel, to suit a fixed velocity, very simple. The depth of the bucket being the only variable quantity.

[TO BE CONTINUED.]

Blasting Rocks under Water by means of the Galvanic Battery.

At page 221, vol. xii, of the last series of this Journal, we published an article by Professor Hare, describing an apparatus for the blasting of rocks by means of galvanic ignition; and it will be seen, by the subjoined letter, that Captain Paris, a well known engineer and architect, of Boston, has applied the proposed means with perfect success, in blasting rocks under water. In the article by Dr. Hare, Mr. Moses Shaw, of Nova Scotia, is mentioned as having first suggested the idea of igniting the powder in blasting rocks, by the aid of the electric fluid. That gentleman had pursued the subject with much persevering industry, contending, at the same time, against pecuniary difficulties, and a want of those resources which science alone can supply, in the prosecution of such undertakings. He well merits, however, to have his name associated with those who have brought the matter to a successful issue.

EDITOR.

DEAR SIR,—Knowing the great interest you have always manifested in all engineering operations connected with the construction of public works, it affords me pleasure to communicate to you an account of the transactions within the past summer at this Navy-Yard, in blasting rocks under water, by means of the galvanic battery.

The application of this means to purposes of blasting, is somewhat novel, as you are well aware, and the account of Colonel Pasley's experiments in England has given to the public the first notice of its being thus employed. Since the blowing up of the wreck of the Royal George, it has been successfully used in England in blasting rocks and clearing harbors, rivers, &c. from obstructions: it bids fair to entirely supercede the old methods of blasting, both in civil and military operations, especially in the latter, where it becomes a tremendous agent for the instantaneous explosion of mines, &c.

In the detailed accounts of the experiments tried by Col. Pasley, it appears that at first, many difficulties were encountered; and the numerous failures seemed to forbid any hope of success in large operations, although the result of those on a smaller scale generally proved satisfactory. Perseverance, however, enabled the operators, after many trials, to render the explosion of the charge under water, as certain as by the ordinary methods on dry land; and the subsequent success in blowing up sunken wrecks, &c. at the bottom of the Medway river, and at Spithead, proved the utility of the means and amply compensated for the labour and expense incurred in the first attempts.

Our operations during the past season were confined chiefly to the construction of quay walls and the foundations of two launching ways, the whole of which were built of stone. The character of the bottom of the river where the work was laid, rendered blasting or other means necessary, before a proper surface for the foundation could be obtained; it was desirable to give it a slight inclination inwards, so that the face of each course of stone should lie somewhat higher than the inside, thus preserving a proper batter of the walls and rendering them perfectly secure. This bottom is a hard slate rock, and, with the exception of some level portions, extremely uneven, with slopes of almost every grade, generally in an outward direction from the shore. The depth of water in the line of the walls varies from fifteen to twenty feet at low water, and from twenty-five to thirty below the high tides. This depth of water added to a strong and variable current, caused me to anticipate much difficulty and great expense in all operations below its surface.

But we were fortunately provided with a fine diving apparatus, consisting of a cast iron diving bell and a powerful air pump attached. This apparatus was worked from a vessel of strong construction and light draught, fitted expressly for the purpose. A system of signals and messengers was established for communication between the workmen in the bell and those on board the vessel; by these means every want was speedily made known and answered. Four workmen, divided in two gangs were employed for working in the bell, which made four descents per day, occupying at each time two and a half hours, the two gangs alternately relieving each other. The bell was amply supplied with a constant stream of fresh air, and but two or three inches of water remained in it at its greatest depth, so that the men worked in a comfortable state, perfectly dry and with no more difficulty of respiration than on dry land.

In deciding upon the best means for preparing the bottom for the reception of the foundation of the walls, I was greatly at loss which to adopt. It appeared to me that in adopting the method practised

by Col. Pasley, great expense and difficulty would be incurred; and as it did not appear that this method had been employed in blasting the solid rock at the bottom of a river, in any of his experiments, I was somewhat apprehensive of its utility for operations of this kind, and whether the cost would justify the trial. In order to satisfy myself with regard to the expense of an experiment with the galvanic battery, I applied to Mr. Daniel Davis, Jr., philosophical instrument maker, of Boston, for the necessary information, when I was convinced that a very trifling expense would procure such a trial as would satisfactorily decide the merits of the apparatus. Mr. Davis kindly assisted me in making the experiments which were tried at the Navy Yard at Charlestown, and I had the pleasure of witnessing the most satisfactory results, and without hesitation determined to apply the means to the work in hand.

The galvanic battery which was constructed by Mr. Davis, was one of Doct. Hare's invention, of Philadelphia. It consists of two vessels or jars, each formed by two concentric cylinders of copper, admitting of a cylinder of zinc between. Two copper wires termed the conducting wires formed the medium by which the electrical fluid was communicated to the charge from the battery. These wires were closely wound with thread in order to prevent their coming in contact with each other, and both tightly covered with tape, and afterwards served round with twine, thus forming a single coil. At each extremity of the coil the wires were separated for a few inches like a fork. This form of the galvanic battery, termed by Doct. Hare, the "Calorimoter," is the most simple and portable of any that I have seen; its power for blasting gunpowder may be increased to any required degree, either by enlarging the size of the jars or increasing their number. We had, in addition to this apparatus, a simple contrivance for proving the charges of powder, which is termed the "Electrometer."

The charges used in blasting consisted of various quantities of gunpowder, according to the effect required, from four ounces to a pound. They were enclosed in perfectly air tight tin cannisters, the smallest being an inch and a quarter in diameter, and the diameter of the largest about two inches; the lengths of the cannisters were eight or nine inches. Two copper wires were introduced into the cannister about half way down, with the extremities connected by a fine platinum wire; the other ends of the wires projected twenty or twenty-five inches beyond the mouth of the cannister, which after being filled with powder was closed and effectually secured with a water-proof composition. It will be observed in thus preparing the charges that

the whole is completely air and water tight, and that no vent to the powder remains, an advantage of which I shall further speak.

The operation of blasting is carried on in the following manner: The hole in the rock for the reception of the charge is drilled to a proper depth by the workmen in the bell; the cannister is then inserted with the ends of the copper wires extending outside of the hole, which is then filled up or tamped with coarse sand. The ends of the conducting wires are then connected by means of clamps to the wires leading from the charge; the other end of the coil is then led up, as the bell is hoisted to the surface, to the battery, which in all our experiments was placed on a floating stage directly over the charge. The jars forming the battery are brought near each other, and their whole power concentrated by connecting them together with a short copper wire; the end of one of the conducting wires is then brought in contact with one pole of the battery, and the end of the remaining wire similarly disposed with the other pole, when the explosion instantly follows by the platinum wire in the charge becoming intensely heated as the electrical current passes through the conducting wires.

We made during the past season nine blasts, with but one failure, which was caused by the platinum wire in the charge becoming accidentally broken, so as to render the electrical circle incomplete; this probably occurred in tamping, an operation which must be conducted with care, as this accident is most liable to be incurred, of all others, owing to the extreme delicacy of the wire. The object of the electrometer is to detect whether this has taken place before the charge is inserted in the rock, and may always be ascertained by a simple trial.

It must be obvious to every one, at all experienced in blasting rocks, that this method has advantages in many respects over the old methods, both under and out of water. The danger of accidental explosions is entirely prevented; these occur for the most part in the old practice by carelessness, while in this, great care and nicety are required to produce the explosion. There is very little time required in charging, as the cannister is simply inserted in the hole and tamped with sand; the whole time occupied in this operation and making the connection with the conducting wires in the present cases rarely exceeded twenty minutes. There is great expense and trouble saved in the absence of the train or fuse, which was indispensable in the old methods, especially under water, where was always required a water-tight hose or tube leading to the surface, which was always destroyed by the explosion. Here nothing is lost or injured except the cannister containing the charge. The explosion of the charge is

reduced almost to certainty, and should cases of failure occur, it can be approached with safety, without the suspicion that fire may be near it. The most important advantage in an economical view, is that the effect of the charges is much greater than in the old way, in consequence of there being no vent-hole; the whole explosive force of the powder is thus gained, while by the old methods much of it is lost. Our smallest charges displaced a much greater quantity of rock than the same amount of powder by the old means, which we had opportunities of experiencing. With these advantages, this method of blasting places in our hands the most ample means of clearing harbours and rivers of rocks, &c. in any reasonable depth of water.

In using Doct. Hare's apparatus, it appeared that an important advantage was gained over that of Professor Daniell's, employed by Col. Pasley, inasmuch as a very troublesome arrangement, indispensable in the latter, was avoided. This consisted in not being obliged to insulate the conducting wires from the water, as in such a case the connection of the conducting wires with the charge must be made before the cannisters are placed in the rock; every portion, then, of the wires where the connection is made, must be covered with the waterproof composition. By Professor Daniell's apparatus, it appeared that water was a conductor, thus destroying the electrical circle, if any part of the conducting wires came in contact with it.

Though Doct. Hare's battery was known to Col. Pasley, it was not adopted in his experiments, the reason assigned being that "it did not appear that he had ever used it under water."

I have the honour, Sir, to be,

Your obedient servant,

Alexander Paris, Civil Engineer.

Col. S. Thayer, Boston.

Navy Yard, Portsmouth, N. H., Nov. 9, 1840.

An Account of the Establishment for the Manufacture of White Lead, from the Pulpy Oxide of Lead, under the Patent granted to Mr. G. F. Hagner.

At page 274, of the last volume, we published an article "On the manufacture of white lead from the pulpy oxide prepared by trituration," in which we intimated that we expected to obtain some further information upon this subject. The subjoined letter, from a gentleman who was a principal in the undertaking, affords this information; and the character of the writer for intelligence and integrity, is too well known to be strengthened by any thing that we could say. Patents have been obtained, within a few years, by persons

who appeared to consider the triturating process itself to be new, as described by them; the facts which we have before published, together with those detailed in the accompanying letter, must put this question at rest; and it will also appear that the proceeding in some other particulars was substantially the same with such as have been since claimed by others.

To the Editor of the Journal of the Franklin Institute.

Shamokin, 12th Month, 21st, 1840.

Respected friend.—A succession of engagements have prevented an earlier reply to the inquiries made by thee respecting what I know relative to the discovery of making white lead by attrition, I now offer, from recollection, the following facts, my papers relating to them, being in Philadelphia.

I spent the winter of 1817–18, in London, and there met, for the first time, with Geo. F. Hagner, of the county of Philadelphia. He informed me that he had discovered a method of making white lead by attrition, that he had obtained a patent for his discovery in the United States, and that he had come to Europe for the purpose of procuring patents in such kingdoms as he might think it his interest so to do; my belief is that he entered caveats, or took out patents, for England, Scotland, and Ireland. In the following spring, he went to the continent, and remained there for some time.

About this period, Jos. Richards, who had, for several years, been engaged in manufacturing white lead, by the old process, built a mill, and put up machinery, at the Falls of Schuylkill, for making lead by attrition; whether the plan pursued by him was identically the same as that patented and claimed by G. F. Hagner, I am unable to say, never having seen his works, the water power of his mill being destroyed, in common with all other power, at the Falls, by the dam at Fairmount. I did, however, see a portion of his machinery, which differed materially from that used and approved by G. F. Hagner.

Soon after I returned home from Europe, I met with G. F. Hagner, and was induced to invest a considerable sum of money in manufacturing white lead by his process. We commenced in the spring of 1820, in a small mill, on the west bank of the Schuylkill, below Flat Rock, but soon after removed to a mill built near the locks on the canal, at Manayunk. The first process was to melt the pig lead, and reduce it into very fine particles, as fine as gunpowder. The process by which this was done, was cheap and rapid, but as G. F. Hagner never patented it, and kept it a secret from the workmen, I do not feel at liberty to describe it; I may, however, mention that the lead was not dropped into water, as stated in an article of the September No. of

the Journal. The granulated lead was put into large cylinders made of wood, and lined with sheet lead. These cylinders were about six feet long, by four feet six inches wide at one end, and three feet at the other. The small end was open. They revolved on an axle passing through the centre. With the lead was put vinegar, or water, and as the liquid became thick with the white oxide, it was taken out and fresh lead and vinegar added. The white oxide was allowed to settle; was washed to rid it of the acid, then dried, and ground in oil, as usual. The article, as thus manufactured, had great specific gravity, covered well, and resisted the effects of sun and weather better than white lead made by the old process. It dried quickly, without the use of litharge, it was well adapted for outside use, but not for the interior of houses, as it became very yellow in confined rooms; on account of this property it was not liked, and we expended considerable money to overcome this difficulty. In the course of our experiments I deemed it prudent to consult our late worthy and esteemed friend, Wm. H. Keating, then Professor of chemistry, in the Faculty of Arts, in the University of Pennsylvania, who analyzed some of our white lead, and gave us his opinion respecting it. He had in his possession, at that period, an apparatus that had been used on the Brandywine, by a friend of his, in trying a set of experiments to produce the same result that we were trying to effect. This apparatus he lent us, and we used it at Manayunk.

After having spent many months, and undergone much labour of body and mind, and having also expended a considerable sum of money, we believed that we had arrived at a mode by which we could make a perfect article; but as we had not room enough to operate in the part of the mill we occupied, I sold out at Manayunk, and erected buildings at Norristown, adapted to our purpose, in which we could make two tons of white lead in every twenty-four hours.

In this new establishment, we put up the large cylinders before described, but did not depend alone on the white oxide made in them; all that was made in these was used by us; but our principal dependence was upon litharge. The litharge, or the white pulpy oxide, either together or separate, was run through a pair of mill stones, with distilled vinegar, and in this liquid state the ground material was passed through a set of tubes or cylinders connected by copper pipes. These cylinders were air tight, lay on their sides, and were fitted up with dashers much like a common butter churn. With the litharge and vinegar, was forced into the cylinder a large quantity of carbonic acid gas. These materials passed through eight cylinders with dashers, and into a ninth, without dashers; from this last cylinder the gas passed into the open air through a high copper tube, and the

liquid into tubs placed on the floor, so as to admit of the settling of the lead; these tubs were connected with tubes which allowed the vinegar to pass into a reservoir, to be used over again.

The lead was then washed to get clear of the acid, dryed, and ground, as usual. The white lead thus made, was a perfectly carbonated article, very fine and white. Its specific gravity was less than that of the best white lead made on the old plan, and hence there arose an opinion in the mind of the consumer, that it was adulterated. At the exhibition of the Franklin Institute, in the year 1826, I obtained the premium, in competition with the best lead there. The article we made was beautiful, and the arrangement as complete as any I ever saw.

In justice to Philip Mayer, a German, of considerable chemical and mechanical knowledge, I should say, we had his aid in this establishment.

In conclusion, I may state, we had the result of upwards of two thousand experiments, tried during a period of five years, and that finally we succeeded, so far as to produce a truly excellent article. To give a description of our numerous experiments, would fill a number of the Journal.

In this letter, I have endeavoured to give the kind of information which I believe was desired by thee; if not, please inform me, and I shall be glad to afford thee any other in my power.

I am, very respectfully, thy friend,

Samuel R. Wood.

In the foregoing letter, the writer mentions that the lead was granulated by a process which Mr. Hagner did not communicate to his workmen, and which he, therefore, does not feel himself authorized to disclose; we, however, are at liberty to offer our conjectures respecting the manner in which the granulation spoken of was effected, and which, we suppose, was upon a principle well understood by chemists, and others. We apprehend that the lead, in a fused state, was submitted to continued agitation in a revolving iron cylinder, or other suitable vessel, the agitation being continued until the metal had set, or lost its fluidity, when it would be found in the state of fine grains, as above described.

On Indigo.

Part 1*st. The constituents of ordinary Indigo.*—Of all colouring materials employed in dyeing and printing on vegetable or animal fibre, indigo claims pre-eminent rank, whether in regard to its beauty,

durability, or the variety of methods of application, and indeed in respect to its fastness or permanency, it is unequalled by many, and scarcely excelled by any of the colours derived from the mineral kingdom, when exposed to ordinary atmospheric agents. These considerations, and the fact of its very extended employment in colouring processes, point it out as worthy of peculiar attention and close investigation, in order to a thorough knowledge of its characteristic properties, and chemical relations, which, although not sufficiently examined, have nevertheless been rendered more intelligible, chiefly by the experiments of Berzelius.

In the state in which it occurs in commerce, it has long been known to be composed of a blue colouring matter, with various other ingredients, which were very imperfectly understood, until Berzelius proved that it contained four principal ingredients, together with small quantities of others. These are indigo-gluten, indigo-brown, indigo-red, and indigo-blue.

1. Indigo-gluten is obtained from the indigo of commerce, by treating it in fine powder with dilute sulphuric acid, which extracts it, together with salts of lime and magnesia. The insoluble remainder is boiled several times with water, which takes up more gluten than the acid water. The solution is saturated by carbonate of lime (chalk or marble), filtered, evaporated to dryness, and treated with alcohol. By evaporating the tincture to dryness, the gluten remains as a yellowish, or yellowish brown, transparent and shining varnish. In its behaviour towards reagents it resembles gluten, differing from it by its solubility in water, and its want of adhesiveness; it differs from vegetable albumen by its solubility in alcohol, and its not coagulating by ebullition.

2. Indigo-brown is obtained by treating the insoluble remainder after extracting the gluten by a concentrated solution of caustic potassa, with the assistance of warmth. The mass becomes instantly black, and swells up to a porous paste, in proportion as the brown colour dissolves. It is diluted and filtered, and the filter slightly washed. The solution neutralized, and then acidulated by sulphuric acid, suffers the brown to precipitate, which may then be washed. As it still contains a portion of indigo blue, it is dissolved in carbonate of ammonia, evaporated to dryness, dissolved in a little water and filtered, by which operation, the blue, with a portion of the brown, remains on the filter. It is exceedingly difficult to obtain it perfectly free from other substances, so that it cannot be said that we understand the nature of the pure brown substance. In its purest form it is a transparent, shining, brown varnish, slightly soluble in water, with neither an alkaline nor acid reaction. It combines eagerly with

acids, forming combinations, which are difficultly soluble in water. It unites so powerfully with alkalies, that the resulting compounds, although soluble in water, give no alkaline reaction with reddened litmus paper.

3. Indigo-red is obtained by boiling the remainder from the preceding operations, with alcohol of 0.83. Being difficultly soluble in alcohol, it is requisite to submit the residue to repeated boilings. After some time, the red solution passing through the filter, assumes a blue colour, from the presence of indigo blue. When the alcoholic liquid is concentrated by distillation, a blackish brown powder deposites, which, separated by filtration and washing, is indigo-red. By solution in alcohol or ether, and spontaneous evaporation, it remains as a dark red powder. It is insoluble in water, alkali, or dilute acid. Concentrated sulphuric acid dissolves it with a dark yellow colour, and if wool be placed in the diluted solution for several hours, it decolourises it, while the wool receives a colour varying from a yellowish brown to red. Chlorine water renders indigo-red yellow and soft, like wax, but after exposure to air, it assumes its original character.

4. After the three preceding substancs are separated, the indigo-blue which remains is not absolutely pure, but may be rendered so by the following treatment. It is mingled with quick lime, (about twice the weight of the crude indigo) which is slacked to a powder immediately before its employment, put into a flask capable of containing one hundred and fifty times as much water as indigo, the flask is nearly filled with boiling water, and shaken. Sulphate of iron (copperas) is added (about two-thirds the weight of the lime) in fine powder, or dissolved in a little boiling water, the flask corked tightly, and well shaken. It is suffered to stand a few hours in a warm place, when the liquid assumes a lemon or dark yellow colour, in proportion to its concentration. As soon as the liquid has settled, the clearer portions are drawn off, and the remainder filtered through paper. The indigo blue, separating from the liquid when in contact with the atmosphere, carries down with it a portion of the foreign substances, an inconvenience easily obviated, by pouring the yellow liquid into dilute muriatic acid, which retains them in solution. The precipitate is well shaken until it assumes a full blue colour, then thrown on a filter and thoroughly washed. After it becomes dry, it is no longer of a blue colour, but has a shade of purple, and by friction exhibits a metallic lustre resembling that of copper. Hence the strength of the purple indicates, in some measure, the amount of blue in raw indigo.

Indigo-blue, in its pure form, has neither taste nor smell, exhibits

neither the reaction of an acid nor a base, and in short, is one of the most indifferent substances in its chemical relations. It burns, with difficulty, in the open air, with much smoke, and leaves a charcoal which burns with difficulty. If heated in a close vessel, without the access of air, it is converted into a purple vapour, which is gasiform indigo-blue, and condenses on the cooler portions of the vessel in crystalline scales, of a purple colour and metallic lustre. A considerable quantity of the blue is decomposed by the operation. The same crystals may be obtained from commercial indigo, but they are rendered impure by the sublimation of indigo-red. To perform the operation on a small scale, it is only necessary to place a cone of strong brown paper over a slightly concave tin dish of two or three inches diameter, and heat the latter over a lamp until the paper begins to brown, which heat is maintained until the greater part of the indigo is sublimed. The interior of the cone will be thickly coated with crystals, which can be purified, if requisite, by repeated boiling in fine powder with alcohol, which removes the red.

Indigo-blue is insoluble in water, alcohol, ether, olive oil, or spirits of turpentine. It is not affected by dilute acids, nor caustic alkalies. Chlorine instantly decomposes it, and renders it yellow. It is readily deoxidized by substances which have a strong affinity for oxygen, provided an alkali or alkaline earth be present, in which case the reduced indigo combines with the strong base. It is dissolved by concentrated sulphuric acid, but changed in a very remarkable manner. It is farther decomposed by nitric acid, giving rise to new and singular products. These chemical relations of indigo will occupy our attention in the succeeding part of the essay.

It appears, therefore, from the preceding, that there are four principal organic constituents in indigo, beside others in smaller quantity. Of these, the blue rarely attains 50 per cent. of the weight of the raw material; the red and brown are each present in larger proportion than the gluten. Beside these, there are mineral substances contained in it, either accidental or adulterations, such as silica, lime, magnesia, oxide of iron, alumina, potassa, and a little phosphoric acid.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

Letter VIII.

(Continued from page 82.)

6. *Cost of Running Steamboats.*

The expenses incident to the management of steamboats, consists in the salaries and wages of the individuals employed, the cost of fuel (wood), of the victuals for the cabin passengers and crew, and in the cost of repairs of the boat and engines.

I have mentioned, under No. 4, the extraordinary rise in wages, which took place during the last few years; the cause of it lies principally in the considerably increased number of steamboats, and the want of useful individuals, as also in the universal rise of prices of all articles in the United States. The payments to the officers and crew of the "Franklin," are, per month, as follows, viz:

1 Captain and 2 clerks, - - -	$200
2 pilots, - - - - -	200
2 engineers and 2 assistants, - - -	250
2 mates, - - - - - -	80
1 carpenter, - - - - -	30
2 cooks, - - - - -	80
1 steward and 6 waiters, - - -	140
1 chambermaid, - - - -	20
10 firemen, - - - - -	200
6 common labourers, - - - -	120
38 persons, - - total, -	$1320
Add for 785 cords of wood, and a few tons of coal,	1775
" provisions for 62 cabin passengers, and 38 men belonging to the boat, together for 100 persons, - - -	1400
Total expenses, without repairs, - -	$4495

or nearly forty-five hundred dollars per month. During nine months in the year, the boat makes daily, a trip of one hundred and fifty miles, together, forty thousand five hundred miles per year; during the remaining three months, she is laid by, on account of the low

stage of the water in the river. She then is newly caulked, painted, and receives all the necessary repairs. The latter amount, with a new boat of this class, to not more than three thousand dollars in the first year, to which an amount has to be added for general depreciation, which is considerable. The timber of which the vessels are constructed here, is grown so fast, under a warm climate, that a vessel seldom lasts over six or seven years; but steamboats of the first class are used only four years, and then sold; the new proprietor continues to employ the boat for a few years longer, but her voyages are not so certain. Twenty-five per cent. of the original cost must therefore be taken as the amount for depreciation, in the first year, which makes seventy-five hundred dollars for the steamboat "Franklin;" at the end of the first year the value of the boat is therefore only twenty-two thousand five hundred dollars. In the second year, twenty-five per cent. of these twenty-two thousand five hundred dollars, or five thousand six hundred and twenty-five dollars are taken for the general depreciation; but the repairs in the second year amount to so much more, that their cost, together with the sum for general depreciation, is again equal to ten thousand five hundred dollars, as in the first year. The same calculation is applicable for the third and fourth year, after which, the value of the boat remains only nine thousand four hundred and ninety-two dollars, for which amount it is then sold.

We have, therefore, the following, as the yearly expenses for the steamboat "Franklin."

Current expenses during 9 months running time,	$40,500
During the remaining 3 months, the salary of the Captain and clerks, who remain on the boat, while the others are dismissed, amounts to	1,000
Repairs and general depreciation, - - -	10,500
Insurance, 7 to 9 per cent. on three-fourths of the value, to which steamboats can only be insured,	1,350
Sundry small expenses, - - -	1,150
Total, - -	54,500
If from this sum be deducted the expenses for boarding the passengers and servants, say about	14,000
There remain as the expenses for running the boat alone,	$40,500

As this steamboat peforms during nine months, daily, one hundred and fifty miles, or in the whole, forty thousand five hundred miles, the expenses for every mile the boat travels, amount to one dollar.

On the other side, the revenues of this boat are, at an average, for each trip, of one hundred and fifty miles:

From	62 cabin passengers, at $4, - -	$248
"	63 deck passengers, at $1, - - -	63
	125 passengers, at an average, per trip.	
For	25 tons of goods, at $3, - - -	75
"	transportation of U. S. mail, - -	4
	Total, -	$390

The amount of four dollars, received for transporting the mail one hundred and fifty miles, is, here, very small; the reason is, that the public prefer the mail boats to all others, on account of their safety and punctuality, in consequence of which, steamboat proprietors contract for the carrying of the mail even at the very lowest prices. The income of three hundred and ninety dollars per day, gives, for the nine months, one hundred and five thousand three hundred dollars, which, compared with the expense of fifty-four thousand five hundred dollars, shows an annual profit of fifty thousand eight hundred dollars. As the "Franklin" has only cost thirty thousand dollars, we see what an enormous profit those steamboats yield in America, which are frequented by a sufficient number of passengers.

The steamboat "Ambassador," the tonnage of which is twice as great as of the "Franklin," commenced her trips late in the Fall of 1837, and made, in that year, four voyages from Louisville to New Orleans, each of fourteen hundred and fifty miles, and four voyages back, together, therefore, running a distance of eleven thousand six hundred miles. The monthly expenses were eighty-five hundred dollars, which gives, for three months, twenty-five thousand five hundred dollars, or, per mile of travel, two dollars and twenty cents. In the year 1838, the "Ambassador" made ten trips from Louisville to New Orleans and back, and performed, therefore, twenty-nine thousand two hundred miles, within the period of eight months, the trips having been discontinued during four summer months, on account of low water. The total expenses for the whole year amounted to something over fifty-eight thousand dollars, which gives two dollars as the expense for running one mile. The salaries upon this boat amount, in consequence of her large size, and the long trips, to much more than upon the "Franklin," and are as follows, viz:

1 Captain receives, per year, - -	$2,000
1 first clerk, - - - -	1,200
1 second clerk, $50 per month, therefore in 8 months,	400
1 bar-keeper, $45 " " "	360

2 pilots, each $300 " " " both,	4,800
2 engineers, each $150 per month, out of which he has to pay his assistant; both in 8 months,	2,400
2 mates, one 75, and one $50 per month, therefore both in 8 months, - -	1,000
1 ship carpenter, $60 per month, therefore in 8 months,	480
2 cooks, one 50, the other $30 " " both,	640
1 steward, $85, and 6 waiters, each $25, all in 7 and 8 months, - - - - -	1,880
1 chambermaid, $25, and one washer woman, $20 per month, both in 8 months, - -	360
16 firemen, each $35, all in eight months,	4,480
8 common labourers, each $25 per month, all in 8 months, - - - - -	1,600
48 individuals receive, in total, - -	$21,600

As they have, at the same time, free board on the steamboat, it is evident that the expenses for the persons employed on the boats, are much larger here, than in any part of Europe. The above stated expense of two dollars per mile of travel, includes the cost for board of the passengers, but at the same time, no sum for general depreciation has been taken into account. These amounts will very nearly counterbalance each other, and therefore we may, on this boat, as well as on other first class steamers of four hundred to five hundred tons burden, take the expense, for every mile of travel, at two dollars.

The "Ambassador" carried, in 1838, at an average, one hundred cabin passengers, each of whom paid fifty dollars per passage up, and forty dollars per passage down the river, and one hundred to one hundred and fifty deck passengers, who paid, in part, five, and in part, eight dollars each; finally she carried, generally, two hundred tons of goods up, and three hundred tons down. The receipts, per trip, of fourteen hundred and fifty miles, were frequently seventy-five hundred dollars, while the expenses did not amount to more than twenty-nine hundred dollars, leaving, therefore, a very considerable net profit. On her trips, in 1839, the "Ambassador" averaged only, up to the month of June, sixty-five cabin passengers per trip, but nevertheless, the boat will again give a handsome profit.

The steamboats "Franklin" and "Ambassador" belong, as I observed, to the most elegant, and charge, therefore, highest; boats of a cheaper construction, and less elegant, with their crew not so well paid, incur much less expenses; and we find boats of two hundred and more tons, on which the expenses, per mile of travel, are only fifty cents. If, therefore, these boats only carry thirty-four passen-

gers at an average, each paying one and one half cent per mile, the expenses are already covered. Should the number of passengers be less, or the expense of running greater, the charges for transportation must be increased.

The steamboats between Wilmington, N. C. and Charleston, S. C., which run one hundred and sixty miles along the sea coast, performed, from the 1st of June, 1838, to the 1st of February, 1839, in the whole, two hundred and ninety-seven trips, and carried four thousand and seventy-one through passengers, and twelve hundred and twenty-five way passengers; the number of passengers, per trip, was, therefore, at an average, only eighteen, and still the company does a good business, because the passengers pay five cents per mile, and the steamboats carry goods, and the mail besides. It has been calculated, that a mile of travel, of these boats, after deducting the expenses for victuals, &c. for the passengers, and without taking into account the general depreciation, costs only fifty-four cents, and therefore eleven passengers will cover the daily current expenses.

The steamboat "Champion," of two hundred and forty tons burden, which makes regular trips between Pensacola and Mobile, performs daily, ninety-eight miles, and the current expenses, per day, amount to one hundred dollars, including the passengers' board; each passenger pays ten dollars for the passage, or ten cents per mile, and the average number of passengers, per day, is only ten; the receipts are, therefore, just sufficient to cover the current expenses.

7. *Comparison of the Cost of Transportation in Steamboats with that upon Rail Roads.*

If we compare the total yearly expenses on the American rail roads, with the number of miles traveled by all the trains during the same period, we find, as an average, that the expenses for every mile a rail road train travels, amount to one dollar; the same, as I have shown, is the cost of running a steamboat of two hundred or three hundred tons, one mile. It is surely a remarkable result, that the travel of a steamboat of two hundred feet in length, costs just as much as the running of a locomotive engine with a train of carriages, of nearly equal length; the speed of the rail roads, however, is somewhat greater than that of the steamboats, the former being twelve to fifteen miles, while the latter, upon the Ohio and Mississippi, will average only twelve miles. If the steamboats carry one hundred or more passengers, per trip, they can afford to take only two cents per passenger, per mile, while the average charge upon rail roads, is five cents; but if only few passengers are carried by steamboats, the price must be increased, and be, as we have seen, sometimes, even as high as

ten cents per mile. Upon the American rail roads, the average number of passengers in a train, is only forty, the charges, per mile, can, therefore, not be less than five cents, in order that the gross income, for every mile, performed by the train, may be two dollars, while one hundred passengers, at two cents per mile, upon steamboats, will give the same gross income (two dollars,) per mile of travel. Every thing depends, therefore, on the number of passengers; if this is great, steamboats and rail roads will pay well; if it is small, both must fail.

Steam navigation has, in every case, the advantage, that it allows or even invites competition and opposition; because hundreds of boats, belonging to as many different proprietors, may navigate the same river. Upon rail roads, on the contrary, the danger would be too great if the same course were allowed, and, therefore, the vehicles of only one company, which, in this manner, exercises a monopoly, are always running. It is owing to the competition of the American steamboats, that passengers are now carried at one-third of a cent per mile, and these low charges have alternately effected the enormous increase of the number of passengers; because passengers will now go round some hundred miles, to reach, for instance, the Mississippi, upon which to continue their journey. It is, in fact, incomprehensible, that on no rail road in America, the trial with low charges has been made; there are only some opposition lines, as between New York and Philadelphia, to be met with.

There is, however, a case where rail roads must be preferred to steamboats, let the number of passengers be large or small. This case will take effect in a few years, with two long rail road lines, now constructing in America. The one goes from New Orleans to Nashville; twenty miles of it have already been completed, over a swamp of unfathomable depth, upon which the whole track is floating, and by this construction alone is distinguished from other rail roads. The length of this road will be from New Orleans to Havanna, on the Tennessee, four hundred and thirty-four miles, while the distance to Havanna, by the Mississippi and Tennessee, amounts to more than three times as much. The other rail road, of one hundred and fifty-six miles in length, will extend from Pensacola to Montgomery, and be constructed in opposition to the steam navigation upon the Alabama river, between Mobile and Montgomery, which is three times greater in extent. In both cases it is certain that a road of one third the length will be preferred by the traveling public, even if the charges upon the steamboats should be one third or one fourth the price per mile.

8. *Steamboat Explosions and their Causes.*

In the official report from the Secretary of the Treasury, dated 13th of December, 1838, it is stated, that since the introduction of steam

navigation, up to the summer of 1838, or during twenty years, two hundred and sixty steamboats, with about two thousand passengers, have perished; this would give, per year, thirteen steamboats, (at an average) and one hundred passengers, which were lost. This loss cannot be regarded as so very considerable, considering that the United States now contain sixteen millions of inhabitants, and that certainly a far greater number of persons are killed upon roads; the explosions of steamboats, which are always described in every paper, with all their horrors, have nevertheless—not in America, but in Europe—greatly excited the public mind. Every traveler has it here in his power, to inform himself of the quality of the boat, and of her passages, before he takes his passage in the same, and with the large competition existing upon those rivers, he is always able to find boats upon whose safety he may rely. As a rule it may be taken, that the boats which have higher charges, are more safe than those which carry cheaper; and with a little precaution, and some more expense, therefore, we may trust ourselves in American steamboats, in which I have traveled myself already some thousands of miles, with the fullest confidence. It is, however, of interest, to know the causes of the disasters.

a. The greatest number of accidents happen upon the Mississippi and Ohio rivers, where the steamboats continue their passage day and night, from New Orleans to Pittsburgh; the length of this voyage is two thousand miles, and including the stoppages, necessary for taking in wood, and for landing and taking passengers on board, the trip is made in ten days up, and six or seven days down the river. In the first case, the engines are, through two hundred and forty hours, constantly at work, during which time the boilers are incessantly heated, though the same is still more the case with the engines in manufactories, and in the Atlantic steamships; it must be considered here, that Pittsburgh lies ten and one half degrees further to the north than New Orleans, and it requires a good health, to support the enormous difference in the temperature of the two cities; it becomes evident that the engineers superintending the engines cannot afford to give the same the required attention, and explosions must, consequently, become more numerous.

b. Many accidents happen by "snags" and "sawyers," so called. They are trees torn away from the banks of the river, which get fast with their roots at some point, and remain in positions most dangerous to the steamboats. Whole islands are sometimes formed by such floating trees. For removing these obstructions, particular machines have been invented, and are constantly employed upon these rivers.

c. The Americans are, as is known, the most enterprizing people in

the world, who justly say of themselves, "*we go always ahead.*" The democrats, here, never like to remain behind one another; on the contrary, each wants to get ahead of the rest. When two steamboats happen to get alongside each other, the passengers will encourage the Captains to run a race, which the latter agree to. The boilers, intended for a pressure of only one hundred pounds per square inch, are, by the accelerated generation of steam, exposed to a pressure of one hundred and fifty, and even two hundred pounds, and this goes sometimes so far, that the trial ends with an explosion. Seldom they have here, as they do in Europe, fixed in the boiler, a plate of a composition which melts at a certain degree of heat, and the fire becomes extinguished by the water. The races are the causes of most of the explosions, and yet they are still constantly taking place. The life of an American is indeed only a constant *racing*, and why should he fear it so much on board the steamboats?

d. In order not to lose too much time, wood is taken in only every twelve hours, the quantity they take, is, for large boats, thirty cords, or three thousand eight hundred and forty cubic feet. As generally hard wood is used, the additional load which the boat receives at once, and on its fore end, amounts to about eighteen hundred cwt., and in consequence thereof, the boat touches the bottom, sometimes, on the flat banks. The taking in of wood lasts one hour, during which, the fire is constantly kept up, and the steam attains a very high pressure, necessary, sometimes, to bring the boat afloat. At the same time, they often neglect to pump the necessary supply of water for the boilers, the iron in the flues becomes bare and red hot by the action of the flame, and when at the starting, the water again fills the boiler, the steam is so suddenly generated, that an explosion is the consequence. Although it is generally known that most explosions occur when the boats start, after having got their supply of wood, the thoughtless travellers remain, notwithstanding, on the fore part of the boat, where they are most exposed.

e. During the nights, it sometimes happens that in the windings of the river, two boats going at a great speed, meet each other, and by the concussion, the weaker boat instantly sinks.

f. I have observed already, that there are only two pilots upon each steamboat, which do their service alternately every four hours, but remain on board for the whole voyage, from New Orleans to Pittsburgh, of two thousand miles. It has never been the practice here to take new pilots from station to station, and the consequence is, that the pilots, not acquainted with such an extent of river, which, at the same time, is subject to so frequent changes, often run aground, and

that then the engineer, by using steam of too high a pressure, exposes the boat to explosions.

At a closer examination of all the causes of steamboat disasters, here we find that they all have their origin in neglect and imprudence. The rapid increase in the number of steamboats, has created such a demand for engineers and pilots, that the able individuals are by far not sufficient, and ignorant persons, not knowing the nature of the dangers, often manage the boats, and it is rather surprising that not more accidents occur. None of the causes which lead here to accidents, exist in Europe; in particular, would the known cautious temper of my German compatriots be sufficient to guard them from disasters of this kind. It is to be regretted, that steam navigation was carried on in America five years before it was successfully tried in Europe; it would be still more to be regretted, if at present, when in twenty years, with an expenditure of forty-five millions of dollars, the Americans have acquired such a mass of experience, and brought steam navigation to such a high degree of perfection, we were still to hesitate, in Europe, to adopt the American plan of construction. The steam navigation companies in Europe ought to compare the data given in this letter with the rate of wages and other prices in Europe, calculate, hereafter, the prices of transportation of passengers and goods, compare the same with their actual prices, and they will see the advantage which would result to them by the adoption of the American system.

[TO BE CONTINUED.]

Description of a new form of Edge Rail, to be called the Z rail, with its supports, fastenings, &c.—Making with it a part of a railway track of a new construction—With estimates of the strength and stiffness of the rail, &c.—and of the cost of the track—and a comparison of it in these particulars, with other forms of railway.

The track now described, will consist of the longitudinal under-sills, (a, a) 3×10 inches in the section, with cross ties (b, b) $3\frac{1}{2} \times 6$ and 7 feet long, placed upon them at intervals of three feet from centre to centre, and upon the cross ties notched one inch deep to receive them, will rest the string pieces (c, c) (of the trapezoidal section shewn) three inches wide at top, five and three-eighths at bottom, and five inches deep. A treenail one and a quarter inches diameter, is driven vertically through the three timbers at each cross tie, excepting the ties on which the string pieces join, where there are two tree-nails of one inch diameter. Both under-sill and string piece are twenty-one feet long, and break joints with the rail, (also twenty-one feet

long) and with each other. The section of the rail (d, d) resembles the letter Z, the head or upper table being turned to the one side of the stem, and the foot or lower table to the opposite side. The rail is placed against the inner side of the string piece, with the upper table lapping over the upper and inner edge of the string piece, and thus bearing on the *top* of the latter; and the lower table resting upon the cross ties, notched down three-eighths of an inch to receive it. A continuous top bearing on the string piece, and detached bottom bearings on the cross ties, are thus obtained. The rail is held against the upright inner side of the string piece by horizontal screw bolts (e, e). every three feet, which pass through the stem of the rail about midway between its top and bottom, and through the string piece; the head of the bolt bearing against the rail, and the nut, with a thin washer, against an open morticed seat in the outer slope of the string piece. These bolts (being nine to each bar of twenty-one feet) are placed at points midway between the cross ties, excepting the two in each bar at its end, which come over the cross ties on which the joints of the rail occur. The rail is further confined latterly at its foot, by the shoulder of the notch into which it descends, and also held down by a hook headed spike (f, f) driven vertically into each cross tie. At each joining of the rails, a cast iron joint plate (g, g) is let into the cross tie, to increase the bearing of the rails at these weaker points; this plate having on the outside a ledge to confine the feet of the rails, and two holes in it to permit the spikes lapping over them, to be driven downwards into the tie. The track thus constructed, will rest on a bed of broken stone, sand or gravel ballasting, ten feet wide at bottom, eight feet at top, and twelve inches deep, which will be filled up to the top of the cross tie, and one inch above the bottom of the string piece, and leave a depth of five and a half inches below the under sill for drainage, &c.

The rail is intended to weigh forty-five pounds per yard—its whole depth is five inches, thickness of stem nine-sixteenths of an inch—top bearing for the tread of the wheel one and a half inches, total breadth of upper table two and one-eighth inches—breadth of bearing of upper table on the string piece one and a half inches—breadth of foot inclusive of stem one and nine-sixteenths inches—the whole breadth of the upper and lower bearing surfaces three and one-sixteenth inches—bolt hole in the stem five-eighths of an inch diameter.

The proposed rail, and the structure of which it is a part, will admit, of course, of a variety of proportions. The forms and sizes of the several parts shewn in the preceding description and annexed drawing, are considered suitable and sufficient for a track intended for the heaviest tonnage and highest speeds. It is hardly necessary to say,

that the rail and its fastenings, in combination with the string piece and cross tie, form the only subjects of claim to invention; as the under-sill, ballasting, attachment by treenails, and even the trapezoidal form of the string piece (for economy of timber) are none of them new elements of the railway structure.*

The following is a brief enumeration of the particulars in which the undersigned considers his new rail an improvement upon the previous forms of the edge rail:

1st.—The lateral support given by the string piece to the rail, aided by the lateral strength given to the stem of the latter by the foot or lower web, permits the bar to be made thin and deep without the danger to which the stem of the T rail is subject, of buckling, or bending sidewise, under vertical pressure. Greater strength and stiffness is thus attained in the Z rail, with a given weight of metal, than in the plain T rail—and also than in the H rail, or Bridge rail; for in both of the latter sections, the width necessarily given to the base, for stability of position on its support, prevents the extension of the depth of the bar, sufficiently for the attainment of the strongest and stiffest form.

2d.—The mode of connection between the Z rail and its string piece, makes the latter supply the place of the heavy and expensive chair demanded by the T rail, while the Z rail still enjoys (and in a still greater degree than the T rail,) the superior strength and stiffness due to the *depth* of its section.

3d.—The same mode of connexion gives a continuous support to the upper table, which is not had by any other form of section. And this support not only extends the bearing surface on the wood, but immediately upholds, by an elastic cushion, that part of the head which, in the T and H rails, is so subject to crush, split off, and wear away under the wheels; a defect of these sections which will, it is believed, occasion ultimately their entire disuse.

* The rail as shown in the drawing, has a slope given to the under side of the upper table, in order to make it a little stronger in its connection with the stem. This makes a corresponding slope in the part of the top of the string piece, forming the seat of the rail. The inclination (though not at all essential to the plan,) is not enough to do any *harm;* as the *friction* of the wood and iron would suffice of itself to prevent *sliding*. The sloping seat of the rail may be easily and quickly prepared, and the corner of the string piece rounded, by a planing tool with a properly shaped cutter. It is well known to be necessary to dress (generally with an adze) the top of the string piece for the common plate rail, to amend imperfect sawing. The string piece of the Z rail will be readily sawed into its trapezoidal form at the mill. The open mortice forming the shoulder of the nut of the screw bolt, will be cut so as to *drain itself* of water falling into it. The treenail head may be caulked and pitched, to keep the water out, or driven obliquely so as to put its upper end under the top of the rail. In other details of construction, improvements may perhaps be made upon the plan now presented, retaining its general features.

4th.—The position of the rail on the *inside* of the string piece, makes the resistance of the rail to the outward lateral thrust of the flanges, as great as that of the string piece itself, a result which cannot be obtained so simply, effectually and economically, by any of the modes of fastening the rail on the *top* of the string piece, which must be employed with the H, or Bridge sections. The push of the flange against the rail, it is well known, is *the* force to be provided against, and this provision is made in the Z rail by the mere effect of its peculiar form; while other rails must be kept laterally in place by auxiliary attachments of iron, the bearing surfaces of which being individually small, must be multiplied expensively and injuriously to the wood, by wounding it at their points of insertion. The fastenings which attach the Z rail to the string piece, are subjected to little or no strain by the side action of the wheels, and are therefore left to the sole duty of maintaining the contact of the bar with its supporting beam, for the preservation of the joint action of the two in resistance to vertical pressure, and securing the correct *line* of the road.

5th.—The attachment of the rail to the string piece by a number of bolts passing through both, efficiently resist the tendency to endwise movement in the rail, the prevention of which has heretofore been so imperfectly guarded against. The contraction and expansion of the bar will be provided for, by the elastic yield of the wood at the bolt holes.

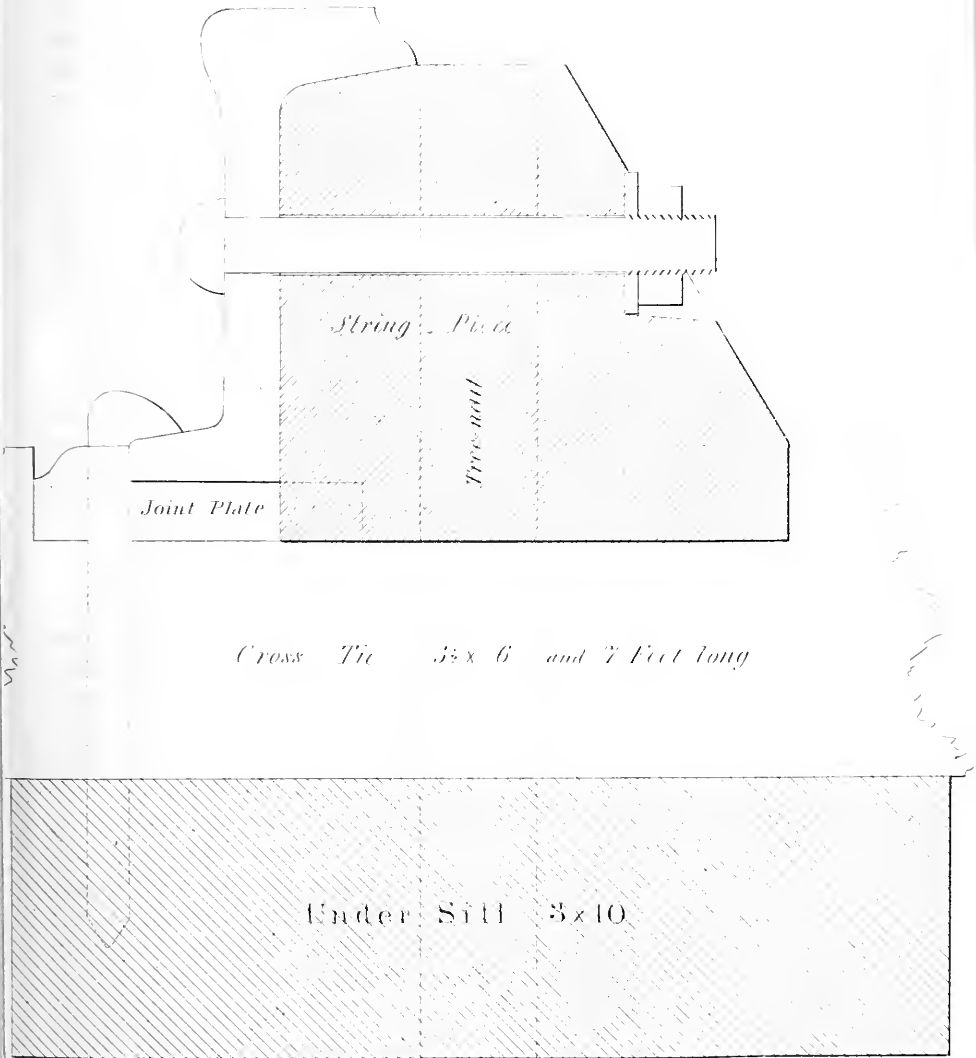
6th.—The *lining* of the inner edges of the rails at the joints, and the springing of the bars to, and their maintenance in, the curve of the road, will be effectually secured by the horizontal attachments of the rail and string piece. The importance and the difficulty of these adjustments must be acknowledged. The difficulty of making the tops of the bars fall in the same horizontal plane, is occasioned by the unavoidable differences in their *heights.* The simplest and best way of compensating these discrepancies is, probably, to raise by a detached elevation, the part of the cast chair or joint plate on which each of the uniting rails is to rest, and then the highest of the two bars can, by a proper tool, have its seat reduced by the amount of the excess in its height. This compensition will be required for the Z rail as for all edge rails. But the lateral adjustment of the rails to a line at the joints will, in the Z rail, be effected simply by the screwing of the stem against the string piece; for after this is done, the break, if any, which may show itself in the line of the inner edges, must be produced by a difference in the thickness of the slender stems of the two contiguous rails, which (unlike the variation in their heights) must be inappreciably small. In the broad base of the H rail as much room exists for discrepancies in the width as in the height of the bar, and

Z. RAIL

HALF SIZE DRAWING

of the Cross Section of

Rail, String-Piece, Cross Tie, Under Sill &c



where the lateral alignment of the rails is effected through the lower web, it is very liable to imperfection. The T rail is less subject to this difficulty than the H rail, and the Bridge rail (in consequence of the facility afforded by the hollow in its base, and into which the chair may be made to go up) still less than either; but the Z rail (it is considered) is the least liable to it of all. And in regard to the bending the bars to, and retaining them in, the line of curvature, the advantage of the Z rail over the H, and Bridge rail, is obvious; both from the more moderate lateral stiffness of the Z rail, and the more direct action and extended resisting surface and adjustibility of its fastenings. The wide bases of the H and ∩ rails on which their strength and stability mainly depend, render them, it is well known, very difficult to deflect in curves, and next to impossible to prevent them from returning to the condition of *chords* from that of arcs, into which they had been temporarily forced in the construction of the track. The great increase of resistance and concussion in the passage of trains through curves situated in this way, need not be demonstrated.

7th.—The Z form of the section is the best adapted to bear the action of the wheels, the *coned* part of which, nearest the flange, imparting the most intense pressure, is received immediately by the *stem* of the rail, in which resides the main strength of every rail bar. In the T and H rails the stem is chiefly acted on through the inner ledge of the upper table, with a twisting action, unfavourable to the resistance of the bar; this part of the head suffering also much more severely from the wheel than the outer ledge. In the Bridge rail, the inner leg or half of the stem receives the principal action; the outer one being strained to a less extent—an inequality injurious to the strength and wear of the rail.

8th.—The simplicity of form of the Z rail section must make the rolling of it easier and cheaper than that of any other edge rail; while the disposition of the fibres and laminæ of the bar is as favourable as possible to strength and the endurance of wear.*

9th.—In efficiency, accessibility and capability of adjustment, the fastenings of the Z rail track possess, it is thought, strong points of superiority. The heavy strains and shocks to which railways are subject, and the consequent disposition of the numerous parts composing their structure, to give way and *work*, one with another, renders it very important that the attachments of those parts should be constantly open to inspection and very accessible. Fastenings capable of being readily tightened after working loose, such as key or screw bolts, are preferable therefore to spikes, or simple screws with-

* This opinion has been confirmed by that of a professional gentleman of great practical experience, in the manufacture of railway bars.

out nuts. But screw bolts used to fasten rails on the *top* of a timber support, must have either head or nut *under* the timber and buried in the ballasting, or filling of the track. In either case the bolt is much more difficult of inspection and adjustment, or removal, than the horizontal bolt of the Z rail.

10th.—The new proposed track is finally recommended by economy in the first cost and subsequent repairs, when contrasted with any known form of track of *equal strength of construction.*

In the "comparative table" below, there are three tracks, viz: the Philadelphia and Reading, the Washington Branch, and the Baltimore and Port Deposit, which are nearly identical with the Z rail track of 45 lbs. per yard, in estimated cost—while three others, viz: the Camden and Amboy, the Newcastle and Frenchtown, and the Wilmington and Susquehanna, fall short of it from $350 to $750 per mile. The comparison of strength, stiffness and general stability between these tracks and the Z rail track (45 lbs. per yard) which is contained in the columns of that table, from the 8th to the 16th inclusive, will, however, justify the claim of greater economy of construction and repairs in behalf of the latter. And if we go to the Z rail track of 35 lbs. per yard, we see an actual saving of $567 per mile in first cost, over the cheapest of the others, and with *all things considered*, a stronger structure; for the strength of the *track*, as a combination of parts, does not depend solely on the strength of the rail, but largely on the stability of the *connexions* of all the parts, in which particulars (as shown in the 14th and 15th columns) the lighter Z rail is seen to be much better provided than the tracks with which it is here compared.

TABLE, exhibiting the comparative weights, strength, stiffness, bearing surfaces, &c., of the Edge Rails used upon some of the principal Railways of the United States, with the relative quantities of timber, &c., employed in the superstructures connected with the several Rails, and the estimated cost of the Tracks per mile.

NAME OF RAIL ROAD, ON WHICH RAIL IS LAID.	Weight of rail per yd. linear.	No. of tons of rails pr. mile, pr. track	No. of lbs. of cast iron fastenings pr. mile.	No. of lbs. of wrought iron fastenings pr. mile.	No. of feet of timber, b'd measure, pr. mile in the track as constructed.	No. of ft. b'd measure pr. mile, with undersill 3x10 added to tracks without one.	Strength of the rail in tons, for a clear bearing of 30 inches.	Strength of the rail and string pieces combined, for same bearing.	Deflection of rail under the weight by which its *strength* is expressed.	Deflection of rail alone, under weight of 8 tons.	Deflect'n of rail & string piece comb'd, under weight of 8 tons.	Bearing surface, in square inches, resisting vertical pressure pr. running yard.	Surface resisting *lateral* pressure pr. lineal yard.	Surface resisting *longitudinal* pressure pr. yard.	Relative *virtual* bearing surfaces, having respect to relative *stiffness* of rails.	Estimated cost of a mile of single track on each plan, by the same scale of prices.
N. Jersey R. Road, T rail	38	59.71	52,800	2,728	63,360	—	4.21	—	.052	.099	—	45.	4.7	.40	25	$10,700
Boston & Worcester, T do.	38½	60.5	52,800	5,280	50,483	—	4.21	—	0.52	.099	—	34½	6.¼	.62	19	10,637
Balt. & Susq'anna, H. do.	58½	91.93	—	16,044	50,688	77,088	12.6	—	.050	.032	—	29.7	3.6	.56	51	11,556
Stoning'n & Provid'e, do.	58	91.14	7,040	4,752	82,720	—	12.6	—	.050	.032	—	22.5	3.75	.62	39	11,149
Long Island, do.	56½	89.	5,632	5,280	61,600	—	12.6	—	.050	.032	—	24.	3.	.62	41	10,587
Boston & Providence, do.	55	86.43	7,040	4,752	36,960	63,360	10.32	—	.054	.042	—	24.	3.	.62	31	10,352
Baltimore & O. R. R. do.	52	81.71	10,548	4,102	53,716	—	8.7	—	.055	.051	—	28.	4.	.62	31	10,354
Philad'a. & Reading, do.	45⅛	71.	5,910	5,005	55,174	81,574	8.11	—	.076	.075	—	26.9	4.	.62	20	9,451
Camden and Amboy, do.	45	70.71	6,600	2,237	60,555	—	7.65	—	.054	.056	—	19.	3.3	.62	19	9,114
N. Castle & F. Town, do.	43½	68.35	1,056	2,259	62,480	—	7.65	—	.054	.056	—	18.	3.5	.62	18	8,736
Washington Branch, do.	40	62.86	9,856	2,112	95,040	—	4.97	18.47	.076	.122	.033	117.	5.	.80	51	9,519
Balt. & P. Deposit, sq. rail,	40	62.86	—	2,959	118,800	—	2.72	23.66	.118	.347	.045	90.	1.12	1.12	14	9,428
Wil. & Susq'a, bridge rail,	40	62.86	11,668	2,816	57,200	—	4.58	—	.077	.135	—	$26\frac{4}{10}$	5.25	.50	11	8,752
Project'd bridge rail track	45	70.71	5,940	3,696	77,778	—	6.12	13.12	.069	.090	.044	130½	2.13	.65	80	9,927
Do. Z rail,	45	70.71	1,509	4,736	67,760	—	8.	10.41	.035	.035	.027	63⅜	9.12	1.60	100	9,482
Do. do.	35	55.02	1,509	3,269	67,760	—	5.72	9.85	.060	.084	.050	63	9.12	1.28	41	8,169

The stability of a railway track, like that of any other piece of framing or machinery, must be proportioned to the values of the resistances it presents to the several strains to which it is subjected. This being granted, as it must be, the undersigned feels himself warranted in appealing to the above tabular statement, as furnishing *demonstration* that the track which he has designed, is superior, in all the elements of stability, to any of its predecessors. In bearing surface to withstand *vertical* pressure, it is *twice* as well provided as the track which approaches nearest to it, and nine times better than the one which falls most short of it.

Its resistance to *lateral* movement, is $1\frac{1}{2}$ times that of the track which comes the closest to it, and 8 times that of the one most behind it.

In the counteraction of *longitudinal* motion, it is better than the best of its competitors by nearly 50, and than the worst by 400 per cent.

Now, that improvement in these particulars in the present structures is wanted, the experience of every rail road company must have taught. The best and most expensively constructed railways of the country, cannot be closely inspected without its being perceived, that the connexions of their parts are too weak to withstand the action of their locomotive machinery. To a greater or less extent, in all those which have come under the examination of the undersigned, the wooden supports are crushed, the iron rails forced aside, and the joints either entirely closed or too widely opened. Spikes, bolts, and other fastenings, frequently give way, and where the maintenance of an accurate adjustment of the track is aimed at, much expense of material and labour, is incurred in replacing them; while the expedients resorted to, for restoring the deranged adjustments, cripple the timber, and convert the originally handsome structure into an unsightly piece of patch-work. There may be lines of railway, which have, in a measure, escaped these derangements; but has the trade and travel upon them been as yet very trying?

It may strike those who examine it, that the dependence of the Z rail, on the string piece, for *lateral* support and maintenance in its upright position, is objectionable. But when it is considered that on the string piece it is equally dependent for *vertical* support, like any other rail of continuous bearing on wood, the difficulty seems to disappear. The Z rail indeed *hangs* by its top on the inner edge of the string piece, just as the common plate rail rests thereon. The Z rail may, in fact, be regarded as an iron plating of the top and inside of the stringer; as long as the latter retains its stability, so long will the former—and we know that the stringer of the plate rail track would

stand very well, if it did not crush under the weights from which its thin bar so poorly protects it. But it will be said, that the Z rail does not bear on the string pieces alone, but also on the cross tie. True, and if the latter bearing acted, or sustained the whole weight independently of the former, the string piece would then perform the office of a simple side support. This it would, indeed, be entirely competent to; but in fact it must of necessity bear the vertical pressure of the rail also, in consequence of the *intended* insufficiency of the tie, to sustain it unaided. The bearing area upon the tie is but nine square inches per running yard of rail, a surface experimentally known to be too small to resist compression in the *hardest woods we have.** Should then, the bearing of the rail, through defective fitting of the parts in construction, be thrown at first on the tie, it will soon become compressed under the travel, so as to bring the top bearing of the rail on the stringer into action; and where the latter bearing is perfect in the first instance, but afterwards withdrawn by *shrinkage of the timber*, the rail gradually indenting the tie as the stringer recedes, will follow the latter and maintain the constant harmony of the two bearings. This expected result depends upon such simple and obvious principles of mechanical action, that the undersigned cannot feel hesitation in his confidence of its occurrence. The amount of shrinkage in the string piece, will not exceed about one-eighth of an inch in extreme cases, and this much, the tie will assuredly compress. The cast iron plate at the joints, extends the tie bearings there, but not more than the rail requires from its greater weakness at those points.

There are, then, the best reasons to believe, that the rail and string piece will act together as a single beam, whose proportional height and width and connexion with its supports, will give it all the stability of position that can be desired. The string piece being fitted close and confined in the notch of the tie by a treenail, it is proposed to compensate for the small shrinkage of the former, by driving a thin wedge between it and the outer shoulder of the notch, so as to keep the gauge of the track from widening. Any other form of rail resting on top of a string piece, would equally indeed require this adjustment. The impression, then, that the dependence of the Z rail on its string piece is, in reality, greater than that of any other section of bar, supported by a continuous bearing, will, it is believed, be removed by reflection from the minds of those who may naturally receive it from a slight examination of the subject, and their ultimate conclusion, it is thought, will be, that the Z rail holds, on the other hand,

* The *locust* ties upon the new track of the Baltimore and Ohio Rail Road, when the bearing area is 28 inches per running yard, have all become more or less indented by the base of the rail.

the best possible position with respect to the timber with which it is connected, and that it will suffer no more from the decay of the wood than will any other rail, upheld in any other manner by a similar material.

BENJAMIN H. LATROBE, *Civil Engineer.*

Sketch of the Vicksburg and Jackson Rail Road, in Mississippi.

The Vicksburg and Jackson rail road extends from Vicksburg, on the Mississippi river, to Jackson, the capital of the State, on Pearl river, being, on the whole, a distance of 45 miles. It was commenced under the engineering supervision of H. S. Van Rensselaer, finished under that of Jeremiah Van Rensselaer, and opened to the public on the 1st of October, 1840.

Nature of the country.—Vicksburg, the western terminus, is situated on the side of that well known range of hills which make their appearance at Fulton, Randolph, and Memphis (the Chickasaw bluffs) in Tennessee, and at Vicksburg, Grand Gulf, Natchez, and Rodney, in Mississippi; they present, however, much less formidable impediments to internal improvement, in the former state, than in the latter, assuming, here, the appearance of small broken knobs, rarely uniting in ridges of any extent, and frequently intersected by ravines containing small streams of water, which, owing to the absence of materials for substantial culverts, have, on this road, rendered frequent recourse to trestle work, necessary. It may be proper here to state that, beside the termini, there are three principal depots, viz. Bolton's, Edward's, and Clinton, at the respective distances of 26, 18, and 34 miles from Vicksburg.

Soil.—The earth in the hills which extend from the Mississippi river to the Big Black, is of a yellow clay colour; it works easily with the pick, stands well, in excavation, at a slope of ½ to 1, and when trimmed with the shovel, will turn the rain, with scarcely any wash; when used on embankment, however, it becomes necessary to sow it with grass. From Big Black to Clinton, the ground is generally flat, and often marshy; the earth in the low ground being of an ashy colour, and making an excellent embankment; as you approach Clinton, the soil takes a sticky nature, melting in every rain, and hardening in the sun, so as to be almost intangible to the pick; in the excavations, great quantities of crystalized gypsum, and sometimes stone, are found, the latter is very soft and deliquesces when exposed to the air; the first mentioned properties of this earth render it very troublesome in *cuts*, it will hardly stand at a slope of 1½ to 1, and, in several places, piles have been driven (in one place, for half a mile,) to prevent its en-

croaches on the track; this kind of soil is found in all the excavations between Clinton and Jackson, which latter place is situated on the low ground of Pearl river, and but little above high water.

The following statement shows the relation between the straight lines and curves from Vicksburg to the depot, one mile from the eastern termination of the road, in the town of Jackson.

	Length in	miles,	and	chains.				
Straight line	"	31	"	76,				
Curves,	"		"	78,	having a radius of		7560	feet.
"	"	4	"	36,	"	"	3780	"
"	"	1	"	46,	"	"	2520	"
"	"	3	"	34,	"	"	1890	"
"	"		"	54,	"	"	1512	"
"	"		"	32,	"	"	1260	"
"	"		"	34,	"	"	1080	"
	Total,	43	"	70.				

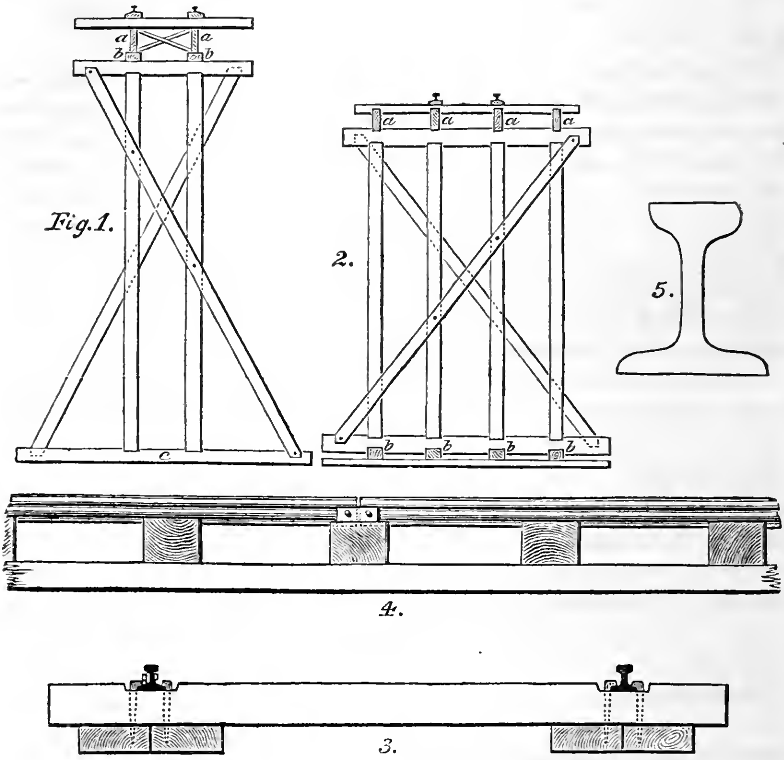
Below, is a view of the amount of the principal grades intermediate to the same points.

	Miles.	Chains.				
Level.	7	22.				
Ascending.	2	26,	at the rate of	55	feet	per mile.
"	1	18,	"	53	"	"
"	2	04,	"	48	"	"
"	5	24,	"	40	"	"
"		57,	"	36	"	"
"		35,	"	35	"	"
"	1	28,	"	32	"	"
"		40,	"	28	"	"
"		40,	"	25	"	"
Descending.		48,	"	50	"	"
"		33,	"	48	"	"
"	3	54,	"	42	"	"
"	3	29,	"	40	"	"
"		22,	"	36	"	"
"		53,	"	34	"	"
"		40,	"	33	"	"
"		67,	"	32	"	"
"	1	32,	"	28	"	"
"		17,	"	24	"	"
"		47,	"	20	"	"

Grading.—The excavations are made 18 feet wide at the bottom,

and sloped at the rate of six inches to the foot, embankments 14 feet wide at top, with a slope of $1\frac{1}{2}$ to 1.

Bridges.—There are seven sets of trestle work upon the road, of which that on the eastern bank of the Big Black river is the most extensive, it reaches half a mile, in spans of 22 ft., being, at its greatest elevation, 52 ft. in height; a section of it is shown in Fig. 1, *a* represents the corbel, or splice cap; *b*, the stringer, 22 feet long; the sill, *c*, is supported by piles, three under the foot of each post, and two under that of each brace.



Trestle work, No. 1, 3 miles from Vicksburg, is 165 feet long, and has an average height of 47.

Nos. 2, 3, and 4; 4, 9, and 11 miles from Vicksburg, are, respectively, 216, 410, and 478 feet in length. The King-post bridge, situated within a few yards of T. W., No. 2, extends 561 feet, in 17 consecutive spans of 33 feet each, supported by trestles, similar to those used at Big Black.

The bridge at the second crossing of Baker's Creek, 26 miles from Vicksburg, is a species of trestle work 100 feet long, in four 25 ft. spans.

The trestles are supported by piles driven into the bed of the creek; a section of it is represented in Fig. 2; *a*, the stringer, *b*, *b*, *b*, *b*, sills, acting as ties to the trestle, at the surface of the water.

The Big Black river is crossed at an elevation of 70 feet, by a bridge on Col. Long's plan, 416 feet long, the main span being 150 feet; this bridge is 17½ feet wide, has a treble set of posts, and quadruple set of stringers on each side, the posts are 20 feet long, and longitudinally of the bridge, 10 feet apart; immediately on leaving the bridge, you arrive at the trestle work, before mentioned.

At the first crossing of Baker's Creek, is a similar bridge, in one span of 80 feet.

Superstructure.—A side and end view of the superstructure are represented in Figs. 3 and 4. It consists of foundation sills, cross-ties, and iron, the sills, $3\frac{1}{2} \times 10$, are laid two and two on each side of the track, to break joints, the cross-ties, 5×7, are 7 feet long, and 2 feet apart from centre to centre. The sills and ties, for about half the length of the road, are cedar, the rest, cypress. The iron, a pattern of which is represented in Fig. 5, weighs 43 lbs. per yard, and is laid down in bars 18 feet in length, in such a way as to break joints; the spikes used, weigh three-fourths of a lb. each, and the plates under the ends of the rails, $2\frac{1}{6}$ lbs. each; 20 of the former are used to each bar.

There are 66 cars, (counting 4 wheels as a car,) at present used for transportation; they are, principally, 8 wheeled, and cost $800 each; 7 engines, 4 of which are of Baldwin's make, are in the possession of the company. The 5 employed during the last 3 months, have, in that time, travelled 26,014 miles, and cost, for repairs, $756, which includes the breakage of a crank.

The expenses for motive power, during the months of October, November, and December, including pay of engineer and fireman, fuel, oil, and repairs of engines, &c., amounted to -	$4,350 50
The maintenance of cars, for the same period,	758 50
The maintenance of way, - - - -	9,278 34
Total expenses for the months of October, November, and December, were, - -	30,348 20
" receipts, - - - - - -	55,015 35
Excess of receipts,	$24,667 15

I have taken the liberty to lay this communication before your readers, from the consideration that a brief account of the result of an enterprize upon which 2¼ millions of dollars, in northern capital, have been expended, might be productive of interest to them, and hope

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that those possessing information relative to the more important ones at the North, will lay it before the public. G. C. W.

Extracts from the Second Report of the Directors of the New York and Erie Rail Road Company, to the Stockholders, February 3rd, 1841. *Signed, by order of the Board of Directors, by* Eleazar Lord, Esq., *President of the Company.**

Of the Route, Surveys, and Relations of the Road.

The route is in all respects most eligible for a work of such extent. Proceeding westwardly, from the harbour of New York, it traverses eleven counties within this State, its course being nearly midway between, and eighty to one hundred and twenty miles distant, from the Erie canal, and the canals which extend westward from Philadelphia. The physical character of the country precludes the construction of any rival work within fifty miles or more on either side; while the numerous streams and valleys which are intersected, afford great advantages of access to adjacent districts on the right and left.

The road will therefore, naturally, command the travel and tonnage of a very wide and extended region, comprising twenty-five or thirty thousand square miles, and a numerous population, besides a large proportion of the travel and traffic of the lakes and western states.

The line, moreover, has the advantage, on more than three quarters of the whole distance, of being laid in the valleys of rivers, and other considerable streams, as the Ramapo, the Delaware, the Susquehanna, the Chemung, the Canisteo, the Genessee, and the Alleghany rivers, and their tributaries, where the grades are extremely favourable, and the soil in the valleys west of the Delaware, adapted to the use of piles.

Excepting the portions previously located, surveys of the entire line of the road have been performed within the past year, including careful, and in some instances, very laborious examinations of different routes. It was the object of these surveys to improve the line as far as possible in respect to its length, grades, curvature, adaptation to the use of piles, economy of construction, and susceptibility of farther amendment with reference to an additional track; the directors having had it specially in view to establish the location where it ought to be, on the supposition of the road hereafter attaining all the importance as a thoroughfare of trade and travel, which the most sanguine have anticipated for it, and at the same time to secure the construction of a single track with the utmost practicable economy.

The original survey by Judge Wright, which possessed extraordinary merit, and entitled him to the enduring gratitude and respect of the company, exhibited a line four hundred and eighty-three miles in length; but at the same time indicated the most important points where farther examinations would probably result in shortening the distance, and in securing other advantages. Between his survey in 1834, and the close of 1838, re-surveys of the whole line and of dif-

* Extracted from the Report and Appendix. Communicated by Major T. S. Brown, C. E.

ferent routes on portions of it, costing, in the aggregate, more than $100,000, resulted in little more than a confirmation of the recommendations and suggestions contained in his report to the Legislature.

The surveys and examinations of the last year leave no room to doubt but that the line selected from Piermont to Deposit, one hundred and fifty-seven miles, and from Binghamton to Dunkirk, two hundred and fifty-one miles, is, taking every important consideration, present and prospective, into view, the best that can be obtained. Its length, allowing thirty-eight miles for the distance from Deposit to Binghamton, is four hundred and forty-six miles. It admits of a convenient and advantageous distribution into divisions, to be worked respectively by locomotives adapted in weight to the ruling grades of the several portions.

Next in importance to the route and location of the road, are its relations to other avenues and sources of travel and business.

Under this head it is obvious, first to notice its relation to the city of New York, the great mart for the products of this and the western states, and of the merchandize to be transported in return, for consumption in the interior; where, from the east and south, the great lines of travel meet, and where emigrants, and other passengers from Europe, for the most part make their landing in the country. When it is considered that the road extends, by the shortest practicable line, from this city to Lake Erie; that it is designed for the transport of heavy tonnage, as well as of passengers; that it will be open for use throughout the year; that the plan of its construction will render it competent to any conceivable amount of business, and that passengers may with safety be transported over it from one extremity to the other, in eighteen or twenty hours; the importance of its connexion with this metropolis, and the value of its local effects here in obviating the disadvantages of a northern climate, and rendering business as active, and supplies as cheap, in the winter as in the summer months, cannot fail to be apparent.

It has been supposed by some, that the termination of the road on the western shore of the Hudson, about twenty miles from this city, would prove disadvantageous, at least for some five or six weeks of the winter season; and in anticipation of such an objection, provision was made in the charter for extending the line to the city, from a point opposite to the Company's pier. Below that point, however, there is seldom, even temporarily, more obstruction from ice than on the ferries opposite to the city. The present winter, owing to the quantity of ice and the occurrence of severe storms, has occasioned difficulties as formidable as are likely to occur hereafter. Nevertheless, the company's boat has regularly performed her daily trips, and by her punctuality and success, has removed all doubt, and established full confidence, of the safety and advantage of this mode of communication with the road.

The pier, which extends about 4000 feet into the Hudson, forms a safe and valuable harbour, in connection with abundant space for all the accommodations of a depot.

Proceeding westwardly, the road passes through the valley of the

Ramapo, and a region of the most valuable iron ores, and divides the county of Orange into nearly equal parts. From Goshen, situate near the centre of the county, railways are proposed to Newburgh, distant about twenty miles; to the line of New Jersey, in a southwesterly direction; and to the north, through Kingston, Saugerties, and Catskill to Albany; of which the two former have been chartered. Near the western boundary of Orange, the line approaches the Delaware river, and intersects the Hudson and Delaware canal, which extends from the Hudson river, near Kingston, to the Anthracite coal beds of Pennsylvania.

In the county of Delaware, a rail road is proposed from Delhi, or from Walton, to Deposit.

In Broome county, the road intersects the Chenango canal, which extends from the Erie canal at Utica to the Susquehanna river; and also the line of a proposed railway from Utica to the Susquehanna, which has been chartered and surveyed; and another from Binghamton through Cortland and Onondaga counties, to Syracuse, and thence to Lake Ontario at Oswego, which has been chartered, and which, in connection with this road, will offer the most direct and eligible route from this city to Upper Canada.

At Oswego, in the county of Tioga, a connection occurs with the Ithaca and Oswego rail road, which extends from the Susquehanna to Cayuga lake, by the navigation of which, it forms an important route from the Erie canal. Near Tioga point, a connection is anticipated with the North Branch canal in Pennsylvania.

In the county of Chemung, the road intersects the Chemung canal at Elmira. The same point is contemplated as the termination of a rail road, which is in part constructed, from Williamsport in Pennsylvania, a distance of about seventy-five miles. To perfect a continuous line of railways from Philadelphia to Elmira, and thence, by a road of this Company, to lake Erie, is a principal object of this road.

It is supposed by some, (who, of course, are not aware how much the grades have been reduced, and the line shortened, on the eastern half of this road, since the original survey,) that on the completion of such a continuous line from Philadelphia to Elmira, the distance and amount of rise and fall between these two points will be less than between Elmira and the eastern termination of this road; and that both trade and travel will therefore be diverted from this route to Philadelphia. An examination of the subject has removed all apprehension of danger from this source. The distance from Elmira to the Hudson at Piermont, supposing the most eligible line from Binghamton to Deposit to be adopted, is two hundred and fifty-two miles, and the aggregate of ascents and descents, 3820 feet. The interval between Piermont and this city is entitled to be regarded only as a ferry.

From Williamsport to Philadelphia, several routes are projected and partly constructed; of which the most direct is that by way of Sunbury, Pottsville and Reading. Of this line, one hundred and fifty-one miles are nearly finished. Its length from Philadelphia to Elmira is two hundred and fifty-eight miles, and its rise and fall 5050 feet. It is moreover, encumbered with nine formidable inclined

planes, on which stationary power will be required, and is therefore not eligible for general trade or passengers. The next route in point of distance, is that via the Muncy Hills, Catawissa, and Reading, of which the length is two hundred and sixty-five miles, and the rise and fall 5530 feet; of this one hundred and fifty-two miles are completed, or far advanced. The third is a modification of the last mentioned route, and passes from Williamsport to Catawissa, by the valleys of the West and North Branch, instead of crossing the Muncy Hills. It is longer than those above referred to, but has less elevation to encounter, its length being two hundred and eighty-three miles, and its rise and fall 4630 feet; one hundred and fifty-two miles are nearly finished. The only remaining route passes down the Susquehanna to Harrisburg, and thence by way of Lancaster to Philadelphia, of which the length is two hundred and seventy-eight miles, the rise and fall 4790 feet, and the portion finished, one hundred and twenty-six miles.

Each of these different routes is in the hands of four or five distinct companies, and of course subject to the disadvantages incidental to separate interests and diverse modes of superstructure and management. The first is placed out of the pale of comparison by its inclined planes. The second is thirteen miles longer, has 1710 feet more of rise and fall, and cannot, from the arrangements of its grades and curves, be worked so economically. The third is longer by thirty-one miles, and has 810 feet more of rise and fall. The fourth has an excess in length of twenty-six miles, and in rise and fall of 970 feet.

Our road therefore, in view of this brief statement, to say nothing of its uniform character and management, or of the preference due to New York as a market, can be considered in no hazard of a diversion of its business by the lines in question, while as routes both of travel and transport from Philadelphia to lake Erie, and for the conveyance of coal and of iron from the district north of Williamsport, the Pennsylvania works will be largely tributary to the productiveness of the road of this Company.

At Corning, in the county of Steuben, the railway, forty miles in length, from Blossburg, in Pennsylvania, occupied chiefly in the transport of bituminous coal, terminates in the line of this road; which also, at the same place, intersects a navigable feeder of the Chemung canal. From Painted Post or Erwin, near the junction of the Canisteo with the Conhocton river, a rail road is proposed to be connected with this, extending up the valley of the Conhocton to the village of Bath, and thence to the Crooked lake.

In the county of Alleghany, at Cuba, the line of the road crosses the Genessee Valley canal, which extends from the Erie canal at Rochester, to the Alleghany river, a distance of one hundred and seven miles.

The line passing down the Olean creek, in the county of Cattaraugus, approaches the Alleghany river, along the northerly side of which it extends about thirty miles.

From the termination at Dunkirk, on the shore of lake Erie, a rail

road has been chartered and surveyed to Buffalo, forty-two miles; and another is proposed in the opposite direction, to be extended along the Southern shore of the lake, into the state of Ohio; from the Eastern border of which state, a continuous line of rail roads has been chartered, and portions of it constructed, through Ohio, Indiana, Michigan and Illinois, to the Mississippi, opposite to St. Louis, to be intersected in Illinois, by a route from the city of Cairo, at the junction of the Ohio and Mississippi.

The harbor of Dunkirk is spacious and secure. It is open earlier, and occasionally some weeks earlier, in the spring and later in the autumn than that of Buffalo.

This brief notice of the relations of this work to those natural and artificial avenues which intersect its route, and are already open, or are confidently anticipated, may serve in some degree to indicate its probable command of business, and its high claims to the confidence of its proprietors and of the public.

An examination of a map of this and the adjoining states, will show that most of the routes of travel and transport above noticed, are intersected nearly at right angles, which sufficiently characterizes them as tributaries instead of rivals. Their aggregate length is far greater than that of the main avenue. Those extending to the right will supply for distribution in the Southern, the salt, lime, gypsum, and various manufactures and products of the Northern counties of this State; while those approaching from the South and West, will furnish for transport from numerous points, anthracite and bituminous coal, iron, and the products of agriculture and of the forest.

Of the Cost of the Work.

The former estimates, as revised in 1835 and 1836, of the cost of constructing the work with a light superstructure and common plate rail, amounted to $6,000,000. In these estimates, however, land-damages, depot buildings, water stations, and some other items, were omitted. Were the road, after being prepared under the contracts which have been made for grading and piling, to be finished with a superstructure like that formerly proposed, the cost would not exceed the amount above represented.

In the estimates above referred to, the cost of grading and preparing the road for the superstructure, amounted to $ 3,900,075. Under the contracts which have been made, and to the extent of about one-third executed, and which cover the entire line, except the section between Binghamton and Deposit, about thirty-eight or forty miles, with an estimate supposed to be liberal for that section, the cost of grading, piling, bridging, masonry, &c., to prepare the road for the superstructure, will amount to $3,840,000. The character of the work, however, which has been, and is to be, executed under these contracts, is deemed to be in some respects much superior to that contemplated in the original estimates, so as to adapt it with an edge rail, to the use of locomotives of double the weight formerly intended, and to the conveyance of proportionately heavier loads. The masonry is accordingly more solid and permanent; the bridges are

stronger, and in some instances, the grades are improved, and the line shortened, at considerable additional expense.

The adoption of piles in the construction of nearly two hundred miles of the road-way, is likewise deemed a great advantage over the ordinary method of grading. The piles used are generally of white oak, about twelve inches in diameter. They are driven by steam power, five feet apart from centre to centre, to such depth in all cases as to secure them from the effects of frost, and with such force as to leave them in no danger of settling under the pressure of any load. The tops of the piles being protected by timbers wide enough to cover them, it is supposed that they may endure about twelve or fifteen years. They form a road of uniformly even surface throughout the year, which is not liable to be obstructed by snow, and while they continue sound, will be subject to little or no expense for repairs. The difference between a piled and graded road for annual repairs will, it is believed, be sufficient in five or six years to defray the entire cost of renewing the piles; while the expense of working such a road, owing to the constant evenness and good condition of the rails, will be very considerably less than is commonly incurred on graded roads.

But though the preparation of the road-bed is not expected to cost more than was formerly contemplated, a very important change has been made in the plan and character of the superstructure, which will materially enhance its expense. The Directors being, after due investigation, satisfied that the ordinary plate rail and light timber formerly proposed, would be inadequate to the objects and business of this road, and in every point of view inexpedient, adopted an edge rail, of the most approved form, weighing fifty-six pounds per lineal yard, which, with the requisite chairs and spikes, will cost, delivered and distributed on the road, about $ 6,800 per mile of single track. This rail, instead of being supported only on cross ties, laid at intervals of three to five feet, as is the case on other roads, is to be laid on heavy longitudinal sills, connected by cross ties framed upon the upper surface, these sills, by giving to the iron a continuous bearing, contribute greatly to the strength and safety of the track.

The cost of this superstructure, including all materials excepting iron, with the labor of framing and laying it down, and laying the rails, will be about $ 1,900 per mile, making the entire cost of the rails, chairs, spikes, timbers and workmanship, $ 8,700 per mile.

Supposing the length of single track required in the first instance, with the necessary side tracks and turn outs, to be five hundred miles, the cost of iron alone, will, on the plan adopted, be $ 3,400,000; and of timber, workmanship, etc., $ 950,000, making $ 4,350,000, which is 74 per cent. more than was formerly allowed for the entire cost of the superstructure.

For the satisfaction of those who are not aware of the considerations which justify so enlarged an expenditure, it may be useful to refer to the experience of others on this subject.

The heaviest wrought iron rails in use in England, prior to the construction of the Liverpool and Manchester railway, were those on

the Stockton and Darlington road, which weighed but twenty-eight pounds to the yard; and proved to be much too light for general traffic, and unsafe for rapid travel. Rails, therefore, weighing thirty-five pounds to the yard, were adopted; but these also proving insufficient, were removed and others of sixty-four pounds were substituted, which still remain in use.

Profiting by the experience of the last mentioned Company, the Directors of the Liverpool and Manchester road adopted in the first instance a rail of thirty-five pounds, then the heaviest which had been used in England. A single year proved its insufficiency, and it was speedily followed by one of forty-four pounds, which again gave place to a different pattern, weighing fifty pounds per yard. A very few of the latter remain at present on the road, those now in use being chiefly of four different patterns, weighing respectively sixty, sixty-two, seventy, and seventy-five pounds per yard. Experience thus induced improvements in the construction, and an increase in the weight and cost of rails, until the vast strength of the forms of section now most approved, was attained.

The rails laid on the Midland Counties road, weighed per yard, - - - - - - -	78 lbs.
Those laid on the Eastern Counties road, - -	76 lbs.
Those on the London and Birmingham, the London and Southampton, and London and Brighton Roads, - - -	75 lbs.
Those on the North Eastern Counties road, - -	69 lbs.
Those on the North Midland, and the Manchester and Birmingham roads, - - - - - -	65 lbs.
Those on the Great North of England road, - - -	62 lbs.
Those on the Great Western, now in progress, - -	56 lbs.

Of these, one only is as light as that adopted for this road; and in that instance, as in ours, the rail has a continuous bearing on a longitudinal sill; while all the others are supported on chairs, at intervals of three to five feet, weighing from twenty to over thirty lbs. each.

In this country, likewise, the results of experience abundantly show, that wherever it is an object to construct a railway, it is to the last degree desirable to obtain a heavy rail. On several roads where a light bar was originally laid, it has been replaced by one better adapted safely to permit rapid traveling, to sustain the severe shocks incident to a heavy trade, and to admit a constant and economical use; of such, the Columbia, New Castle and Frenchtown, Baltimore and Ohio, and others, might be referred to as instances.

The following statement of the cost of superstructure with heavy rails, on several roads, is extracted from a pamphlet published by B. H. Latrobe. The author does not give the actual cost in the several instances, but the calculated cost of the different plans of superstructure, at a tariff of prices, which he deems a fair average of this country:

Baltimore and Susquehanna, - - -	$11,556	per mile.
Stonington and Providence, - - - -	11,149	"
New Jersey, - - - - - -	10,700	"
Boston and Worcester, - - -	10,637	"

Long Island,	$10,587	per mile.
Baltimore and Ohio,	10,354	"
Boston and Providence,	10,352	"
Washington Branch,	9,519	"
Philadelphia and Reading,	9,451	"
Baltimore and Deposit,	9,428	"
Camden and Amboy,	9,114	"
Wilmington and Susquehanna,	8,752	"
Newcastle and Frenchtown,	8,736	"
Average of the above,	$10,026	"
New York and Erie,	8,700	"

It was believed that with a plate rail, the road would be wholly inadequate to the travel and transport which it ought, and, if properly constructed, assuredly would command; that it would be unsafe for passengers, would be subject to enormous expense for repairs, and could not be economically used for the conveyance of tonnage; whereas, with a heavy rail, it would be competent to all its objects, could be worked with economy, would require but a moderate expense for repairs, and would be so much more productive and valuable, as to justify the confidence necessary to render it easier to accomplish its construction on the plan of an enlarged expenditure, than to carry out that originally proposed.

The cost of land and damages will be unusually small, probably not exceeding an average of $ 500 per mile; about three-fourths of the whole line, and suitable sites for depots being released without charge, and further gratuitous cessions being anticipated. Other donations of land having been made of the value, probably, of $ 1,000,000, and certainly more than sufficient to cover the cost of land for the roadway, this item is not brought into view in the following estimate of the cost of the work, viz:

For preparing the roadway for the superstructure, which includes grading, piling, masonry, bridging, fencing and superintendence,	$3,840,000
For iron rails and appendages delivered and distributed,	3,400,000
For timber and workmanship for superstructure,	950,000
For locomotives and cars sufficient for the first operations on the road,	400,000
For passenger and freight depots, machine shops, water stations, engine houses and other necessary buildings,	200,000
For interest and contingencies,	210,000
	$9,000,000

In view of this estimate, which is so far founded on actual contracts, experience, and ascertained facts, as to be deemed worthy of confidence, it is apparent that further resources of capital than are yet at the disposal of the company, will be required. The Directors rely on the stock of the company, after large allowance for the disastrous consequences, to many of the original subscribers, of the conflagration in this city in December, 1835, and the commercial revulsion of the

ensuing years, for at least $3,000,000. The loan of the State heretofore granted, is of the like amount; and they trust that the progress, condition and promise of the undertaking, will be such, before the close of the present year, as to leave no doubt of the expediency, safety, and public utility, of such further aid from the State, as the speedy completion of the work shall require.

The contracts for grading and preparing the roadway, including the superstructure of wood, on about two hundred and forty miles, require the execution of those parts of the work within two years; the payments for which will be discharged by collections on the stock of the company, and the proceeds of State stock yet to be received under the existing law. The farther needful resources will be required for the purchase of iron. On the plan of preparing the roadway within two years, or thereabouts, it is highly desirable that the Company should be enabled to contract for the iron rails, of which 35,000 tons are yet wanted, and for locomotives and cars, in the course of the present year, on account of the length of time required for their manufacture, and delivery on the line of the road. The importance of the entire line being put in use, and rendered productive within the shortest possible period, after the road-bed is prepared, is apparent.

[TO BE CONTINUED.]

Architecture.

The Orders.

It is often asked by those who have never given much attention to the subject of architecture, why *new* orders are not invented, and architects are reproached for adhering to the proportions derived from the ancients. It will not, however, be difficult to show that such censures are unjust, as well as unreasonable.

The orders must either depend for their character on *proportion* or on *embellishment.* If their *proportions* are to be considered as constituting their distinctive qualities, we shall find the number inevitably reduced to three, without the possibility of ever increasing it; but if their *embellishments* are to be regarded as marks of distinction, we shall find *thousands* of orders, both ancient and modern; and almost every architect may claim the credit of having added to the stock.

The *proportions* of the orders are naturally resolved into the *robust*, the *chaste*, and the *elegant*; in the Doric, we have the most massy effect that can be given to a column and entablature, consistent with the principles of beauty; in the Corinthian, we have all the lightness and delicacy that can be attained, without imparting an idea of weakness; while a medium between the two is found in the Ionic. In the Doric, therefore, we have *strength, robustness,* and *masculine* vigour; in the Corinthian, elegance, lightness, and feminine delicacy; and in the Ionic, a beautiful blending of these extremes into chasteness and

dignity. We may therefore attempt, with as much propriety, to add another letter to the alphabet, or another note to the musical scale, as to add to the number of these natural grades of proportion, called orders. Hence, instead of censuring modern architects for not inventing *new* orders, we must abuse the ancients for "using up" all the principles for proportioning them to be found in nature.

But if on the other hand, an order is to be recognised by its *embellishments*, then almost every building of antiquity may be said to be of a different order, as there are scarcely two to be found, in which the decorations of the columns and entablatures are precisely similar: if, for example, we refer to the monument of Lysicrates, and the tower of Andronicus Chyrrhestes, we shall find two antique specimens of the Corinthian order, presenting, in their embellishments, the extremes of poverty and richness, yet no one has ever thought of calling them separate orders. Many examples exist in our own country of columns and entablatures, which differ widely in their decorations from any thing the ancients ever did—Mr. Latrobe, for example, made an order in the entrance to the Supreme Court Room in the capitol at Washington, which is often denominated the *American order;* and if any modification of either of the three grand divisions of columnar architecture is entitled to the distinctive appellation of an order, that undoubtedly is; the shaft of the column is ornamented with the representation of twenty-four stalks of Indian corn, instead of the ordinary flutes and fillets; and the capital has the form of an inverted bell surrounded with eight ears of corn, a portion of the grains of each ear being gracefully displayed between the opening husks; the astragal between the shaft and the capital is made to represent a rope. But this order, novel and ingenious as it is, can only be considered as a modification of the Corinthian, having the same proportions, a bell-shaped capital, and foliated embellishments.

The same may be said of the two orders called Tuscan and Composite, which are usually added in Roman architecture to the three derived from Greece. The Tuscan is a mere coarse adaptation of the Doric, and the Composite, a blending of the Ionic and Corinthian in the proportions of the latter. Vitruvius, who wrote on architecture in the time of Augustus, speaks of these modifications, but nowhere calls them orders. There is, in fact, but *three* orders, the *Doric*, the *Ionic*, and the *Corinthian;* the *Tuscan* and the *Composite* not having the slightest claim to such an appellation.

In this view of the subject, we can never expect the invention of an entirely new order, nor is such an event desirable, even though it were practicable. Columnar architecture having reached *perfection* in the hands of the ancients, any attempt to improve the orders, or

to add to their number, would be nothing short of an attempt to improve perfection.

> "To guard a title that was rich before,
> To gild refined gold, to paint the lily,
> To throw a perfume on the violet,
> To smooth the ice, or add another hue
> Unto the rainbow, or with taper light
> To seek the beauteous eye of heaven to garnish,
> Is wasteful and ridiculous excess."

These observations are, of course, intended to apply exclusively to the art of building with columns. The architect may produce the most elegant compositions without having any reference whatever to the orders; but whenever he finds it necessary to introduce an entablature with insulated supports, he must turn to the principles developed by the ancients. T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1840.
With Remarks and Exemplifications by the Editor.

1. For a *Horse Power;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 10.

In this horse power a vertical shaft is to be turned by means of a sweep, or lever, to which the horse is attached. This lever carries a wheel with teeth on the interior of its rim, which mash into two pinions, or wheels, and these into a pinion on the vertical shaft, an arrangement which is well known. The patentee observes that "it is a point of primary importance that there should be a perfectly equal bearing on the teeth, or leaves, of the pinions, an object which cannot be obtained by mere truth of workmanship." This equal bearing is obtained by allowing a small degree of lateral play to the upper gudgeon of the shaft, to compensate for want of truth, and unequal wear, in the pinions.

The claim is to "the manner of causing the teeth, or leaves, of the pinions to have, at all times, an equal bearing, by allowing play in one direction to the upper gudgeon of the main shaft, within its box, or bearing, as described." This is one of those small things which might suggest itself to any one, but which from its very simplicity is apt to be overlooked; when proposed, however, its utility is perfectly apparent, and is more worthy of a patent than many things requiring much more thought to mature them, but which, when matured, are of little practical utility.

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2. For *Disengaging Horses from Carriages;* Edwin Eastlack, Greenwich, Cumberland County, New Jersey, January 10.

The inventions for disengaging horses, when running away with a carriage, have been numerous, and several patents have been obtained for such inventions both here and in England, not one of which has been continued in use; their abandonment has not resulted from any inherent defectiveness in the means, there not having been any difficulty on this point, although they have, of course, differed in merit. There is a general indisposition to the use of such devices, as if they invited accident, and there is also some doubt whether, in a very large number of cases, it is not more safe to leave the horses attached to, than to disengage them from the carriage.

The arrangements made by the present patentee appear to be well devised, and they are elaborately described; the particular means adopted form the subject matter of the claims.

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3. For improved *Hurdles for Feeding Silk Worms;* Benjamin Benson, Smyrna, Kent County, Delaware, January 10.

"To my hurdle frame I append an endless revolving apron for the purpose of readily removing the filth from the worms; which endless apron I conduct in a manner which renders it much more convenient than the apron employed in the machine of Gamaliel Gay, upon which this is an improvement." "In the apparatus for which letters patent were obtained by Gamaliel Gay, a separate cloth or apron was appropriated to each hurdle, and the rollers upon which it was wound were placed on the sides of the frame, rendering it necessary to employ a much larger space between the respective frames than upon my plan, and greatly increasing its complexity, and the labour of using it." Mr. Benson passes an endless apron under a series of hurdles arranged in a line, and placed one above the other, and this apron is conducted by rollers which cross the hurdle frames, and are turned by means of a winch at one end of it.

Another improvement consists in the particular manner of constructing the hurdles, by which strips of paper are allowed to descend in a fringe-like manner from their lower sides, serving for the worms to mount upon, and also as a convenient lodgment for their cocoons.

The claims made are to "the mode of arranging an endless revolving apron passing lengthwise of a general frame containing several tiers of hurdles for feeding silk worms; it being constructed in such manner as that one apron shall serve to collect and convey the filth from all the hurdles, in the way set forth, likewise the particular manner described of constructing the frames for a lodgment of cocoons, said frames consisting of sides pieces, slats, or covering of cloth, and strips of paper, or other material, combined or united together substantially as set forth.

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4. For a *Steam Cooking Stove;* Peter Getz, City of Lancaster, Pennsylvania, January 11.

This stove is not well represented in the drawing, or clearly described in the specification. Its main feature is the placing of a boiler at its back end, which shall occupy the whole space between the side

plates, and extend from top to bottom, or nearly so, and the placing of a steam chest above the top plate, extending nearly over the whole top, and into which steam is to be admitted from the boiler. The boiler holes are in the upper part of this steam chest, and between its bottom and the top plate of the stove is a flue space. The draught from the fire is to pass through tubes in the lower part of this boiler, into a flue space of about an inch between it and the back plate of the stove. The claim is to "the combination of the tubular boiler with the steam chest, the whole being constructed and arranged substantially as set forth."

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5. For *Wheels for Railroad Cars;* William W. Bergstresser, Harrisburg, Dauphin County, Pennsylvania, January 11.

This car wheel is to have a plate extending from the hub to the rim, and it is to be strengthened by radiating brackets extending from one to the other, as in some other wheels that have been patented; the patentee says: "I would have it understood that I am aware that railroad car wheels have been cast in a single piece, with a concave disk uniting the hub and rim, and provided with brackets to sustain the hub and rim, but in these cases the brackets sustaining the hub are placed on the side of the disk opposite to those sustaining the rim, and I do not therefore claim this as my invention; but what I do claim, and desire to secure by letter patent, is the concave disk in combination with the arms, or spokes, curved in the direction of the concavity of the disk, as described, to prevent breakage in cooling."

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6. For *Evaporating Kettles;* Charles C. P. Crosby, City of Brooklyn, New York, January 11.

"The general nature of my invention or improvement is the use of iron or copper kettles having a square or parallelogram form at the top, or upper edge, with a round or oval bottom, also in setting two or more rows of kettles in an arch, or furnace, with no middle wall, or partition, of brick or stone; also in casting the kettles of less width than length, so that more kettles, each of the same contents, can be placed in an arch or furnace, between the fire furnace and the chimney, than can be of round kettles."

It is proposed to construct the furnace by merely building side and end walls, and it is stated that if kettles four feet long and three feet wide be employed, two such kettles placed end to end, would require the side walls to be seven feet eight inches apart, which will allow two inches bearing for the flanches; that if the arch be eighty feet long, it will contain fifty of these kettles between the fire place and the chimney. The kettles are to have rims, or flanches at top, which are to be rectangular, and are to be supported by the resting of these flanches on bars or gratings of iron, extending from wall to wall.

The particular purpose to which these kettles are to be applied is not mentioned, but it is stated that kettles so constructed and set will evaporate 8000 gallons of water by the use of four cords of wood. The claim is to "the mode of constructing the kettles as herein des-

cribed; viz: by making the bottom of the kettle round, or ovoid, and the top square, or a parallelogram, the sides at the edge being straight, with a flanch or rim on each side of sufficient thickness to give strength to, and support the kettle, say of about two inches; in combination with the mode of setting the kettles in an arch, or furnace, as herein set forth."

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7. For a machine for *Husking and Shelling Corn;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 15.

"My machine consists principally of a vertical conical nut, set with teeth, which is made to revolve within a case or curb, which case or curb is composed in part of movable slats or staves, which are so hinged, or hung, at their upper ends, as to allow their lower ends to move in and out, said lower ends being borne up towards the conical nut by straight, spiral, or other springs, said case or curb also consists in part of stationary pieces of wood, or metal, which are situated between the edges, or joinings of the movable slats or staves, in such manner as to allow said slats to play in and out without opening their joints, so as to admit a grain of corn, or other matter, to insinuate itself between said joints, and consequently to interfere with the action of the machine."

"I do not claim to be the first to have constructed a machine for shelling corn by the aid of a revolving conical nut, furnished with teeth, and placed within a curb; nor do I claim to be the first to have used spring staves to bear the corn up against the revolving nut, but what I do claim in the above machine is the manner in which I have arranged and combined the hinged staves, furnished with springs, with the stationary pieces, so as to allow the said staves to spring out without opening the joints between them."

We have seen this machine in actual operation, and can aver, therefore, that its action is perfect, and that it appears to be capable of performing as much work with the same power as any machine with which we are acquainted.

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8. For *Wheels for propelling Steam Vessels;* Matthew W. King, City of New York, January 15.

The claim under this patent will furnish a good general idea of the nature of the invention.

"What I claim as constituting my invention is the placing of a separate bucket on three or more consecutive rows of arms; the making of the centre arms longer than those towards the sides, so as to increase the diameter of the wheel toward the centre; and the giving to the end of each bucket a rounding form, by which it strikes upon the water more easily and quickly than when made square."

The buckets are to be so placed upon the arms as that their planes shall form an angle with the radii of the wheel, of from twenty to forty-five degrees, so that the revolution of the wheels shall cause the propelling faces of the buckets to leave the water in a position nearly vertical.

9. For *Cleaning Grain, Cooling, Conveying and Bolting Flour;* Aaron Bull, Caroline, Tompkins County, New York, January 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of cleaning, scowering and conveying grain, and cooling, bolting, and conveying flour, by a current of air produced by revolving fans, arranged in a horizontal, or inclined trunk, containing inclined planes for breaking the smut and sheltering the forward wheels from the current of air, and apertures for the escape of the smut, and apertures for the passsage of flour, grain, &c., as described."

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10. For making *Druggists' and other Boxes;* John H. Stevens, Assignee of C. E. Warner, City of New York, January 18.

This patent is taken for a lathe, or machine, for turning round boxes, of wood, such as are used for tooth powders, and various other purposes. This machine is described at great length, and the claims refer by letters to the particular devices as adopted by the patentee. It would be useless to attempt a general description of this machine, nor do we deem it a thing of importance, as we believe that it would be an easy task to perform all the operations with equal facility without interfering with the special arrangements described by the patentee.

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11. For an improved *Braiding Machine;* Dudley D. Sacket, Westfield, Hampden County, Massachusetts, January 22.

Those who know any thing of the braiding machine are aware of its unavoidable complexity. The machine as described in the specification of this patent is substantially the same with that heretofore in use; the improvements made, as pointed out in the claims, are "1st, In attaching the *form* to, and making it revolve with, the *carrier*, as described. 2nd, Attaching to the back of the *racer* a disk which plays into, and is carried by the carrier, as described. 3rd, In the employment of fly guides, for the purpose, and in the manner described."

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12. For making *Wrought Nails* for horse shoes, or other purposes; Theophilus Somerby, Wells, York County, Maine, January 22.

The general operation of this machine is the same with that of several others which have been essayed and abandoned; namely, the forming of nails from a rod, by means of dies formed on, or inserted in, rollers, to which a revolving or vibratory motion is given. This plan, therefore, could not be claimed, and that which is claimed, is contained within very narrow bounds, being to "the shear, or clipper, which separates the nail from the rod, in combination with the dies, and also the employment of the spiral spring inserted in the female die for throwing out the nail."

The defect in machines of this kind is in the formation of a feather, or burr, on the nails, along the closing edges of the dies; a difficulty which the apparatus described will not obviate.

13. For a *Tide and Current Wheel;* F. H. Southworth, City of St. Louis, Missouri, January 23.

"My tide or current wheel consists of a drum, or cylinder, revolving on an axis, which is generally placed vertically; said drum, or cylinder, being surrounded by buckets hinged thereto, so that they may open to receive the action of the water on one side thereof, whilst the buckets on the other side close, so as to pass round in the direction against that of the tide, or current, with little or no resistance. My principal improvement in the said wheel consists in the connecting together of the pairs of buckets which are diametrically opposite to each other, by means of rods jointed to said buckets, so that the opening or closing of one of them shall aid in effecting the reverse action in that with which it is connected." The claim is to the so connecting the buckets; and we have no doubt that the action of such a wheel will be much improved thereby; but in all cases where hinged buckets are to be opened and closed by the current of water, a large portion of the power is lost by the opening not taking place until the buckets have each passed to a considerable distance beyond the point at which it is generally supposed the force of the water will be communicated to them.

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14. For an improvement in the *Construction of Chimneys;* George H. Crossley, New Haven, Huron county, Ohio, January 28.

"The nature of this invention consists in constructing the jambs of the fire-place with two flues in each, said flues opening into a common funnel communicating with the main flue of the chimney, so that the apertures for admitting the air from the fire-places and rooms into the jambs, shall open into separate flues, instead of opening into a common flue; by means of which arrangement a draught will be created through the openings that will aid the draught of the chimney, while in the other case there being but one flue with only two apertures in it for admitting the air, the draught through one of these would have a tendency to obstruct the draught through the other." The foregoing is not a very clear announcement of the nature of the arrangement; nor can we make it clear without devoting more time and space to it than we are disposed to spare, as after a careful examination of the matter, we are not of opinion that the so-called improvement for curing smokey chimneys is likely to be productive of much benefit.

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15. For a *Grubbing Machine;* Young W. Short, Oglethorp county, Georgia, January 28.

This grubbing instrument consists of a piece of wood, or handle, about six feet long, and having another piece of wood about a foot long hinged to one end of it, in such manner as that when closed the handle and short piece will stand at about right-angles with each other. The parts which come together are faced with iron, or steel, grooved or furrowed like the jaws of pincers. The stuff to be grubbed is to be seized between these metallic plates, and the handle then consti-

tutes a lever, and the outer end of the short piece a fulcrum by which the grubbing is to be effected. The claim is to "the combination of the two pieces constructed and operating in the manner and for the purpose herein specified."

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16. For an improvement in *Grist Mills;* Elisha W. Welsh, Paris, Fauquier county, Virginia, January 20.

This improvement is in the manner of "keeping the bushes constantly against the spindles as they wear, and always lubricated;" and the claim is to "the self-adjusting mode of keeping the bush tight against the spindle by means of the wedges acting against the wedge-shaped sections of the bush, either by their own weight, or the addition of weights, as described." The arrangement which is the subject of this patent is so similar to others previously in use as not to merit a distinct description. We should say that there is not any substantial novelty in it, and we believe that any intelligent jury would confirm this opinion.

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17. For a *Plough;* Mahlon Smith, Tinicum, Bucks county, Pennsylvania, January 28.

The claims are to "the mode of securing the reversible cutter and share, by means of the vertical plate and its horizontal flanch, as set forth. To the mode of constructing and arranging the reversible rhomboidal cutter, so as to present four instead of two cutting edges, as described, and to the constructing the movable land-bar with a share, or wing attached, so that both may be advanced together." The numerous variations which are made the subjects of patents in ploughs, if described, would often present minute differences which do not appear to render the instrument either better or worse; and, at all events, an analysis of them would in most cases be equally difficult and profitless. Long continued use is the only test in most cases; and this is one which we cannot apply. In the case before us, we do not find any thing which calls for, or even admits of, special description.

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18. For *Removing Obstructions from Rail Road Tracks*; William and James Thorn, Plainfield, Essex county, New Jersey, January 29.

Two circular brushes are placed in front of the wheels of a locomotive, so that their bristles shall come into contact with the tops of the rails. The shafts upon which these brushes are placed stand horizontally, but making an angle, say of 45° with the rails, and they are driven by the contact of conical, or bevilled wheels, with the flanch of the front driving wheels. The patentees say, "We do not claim to be the inventors of revolving brushes for cleaning rail roads, but what we do claim to have invented is the before described mode of arranging the revolving brushes by placing them obliquely across the track; and in combination therewith the method of communicat-

ing the power to the brushes by means of the flanch on the front driving wheel acting on the conical wheel placed upon the axle of each of the revolving brushes, all as described."

19. For a *Brick Machine;* Julius Willard, city of Baltimore, January 29.

The clay, placed within a box, is to be tempered by the revolution within the box of paddles placed upon a horizontal shaft. From this box the tempered clay is to be forced into a long sliding trough, the depth and width of a brick, and it is thus in part moulded, which moulding is completed by cutting the long strip of clay into proper lengths for a brick by means of wires stretched upon a frame, and so arranged as to answer that purpose. The claim is to "the manner of forming the clay into long strips by means of the moulding trough, constructed as described, and the combination of the same with the carriage and tempering apparatus."

20. For an improvement in the *Shuttle;* James Baldwin, Nashua, Hillsbrough county, New Hampshire, January 31.

"The patentee says that his invention consists in furnishing the shuttle with such a spindle, spring, and catch, as will admit of the four conditions, or particulars, following, to wit: 1st. That the spring and catch be made of one piece, thereby avoiding the expense of separate catches and springs, and of fastening them separately to the body of the shuttle, as in all other shuttles now in use. 2nd. That the catch be fastened to the body of the shuttle by a screw, instead of playing upon a pin. 3rd. That by turning down the spindle with the bobbin upon it, into the mouth of the shuttle, it will be secured, and that it will be released by turning it up. 4th. That the head of the spindle be so formed, and the arrangements be such, that the spring shall press against that part of the head of the spindle which is back of the pin on which the spindle plays, instead of that part which is foward of said pin. The means and advantages of these arrangements are specially set forth and the following claim made.

"What I claim is the above described mode of furnishing the shuttle with a spring and catch in one piece, and so applying the spring to the spindle as that the rounded end of the head of the spindle shall come in contact with the spring, and by turning the spindle the catch is moved so as to release or receive the bobbin without any other operation."

Description of a Self-Acting Brake, for Rail Road Cars, for which letters patent of the United States were granted to George S. Griggs, *of Roxbury, in the county of Norfolk, Massachusetts, December 31st,* 1839.

We have been furnished by the patentee with the accompanying engravings of this apparatus, but as the view given of it, and the let-

ters of reference, do not correspond with those of the specification and drawings in the patent office, we give the following references to the engravings, and also the concluding part of the specification.

Fig. 1.

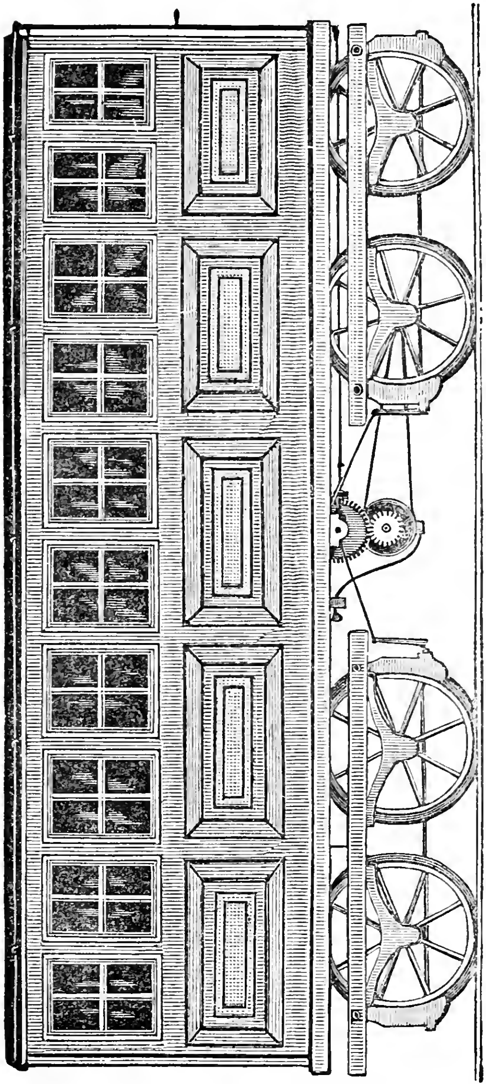


Fig. 2.

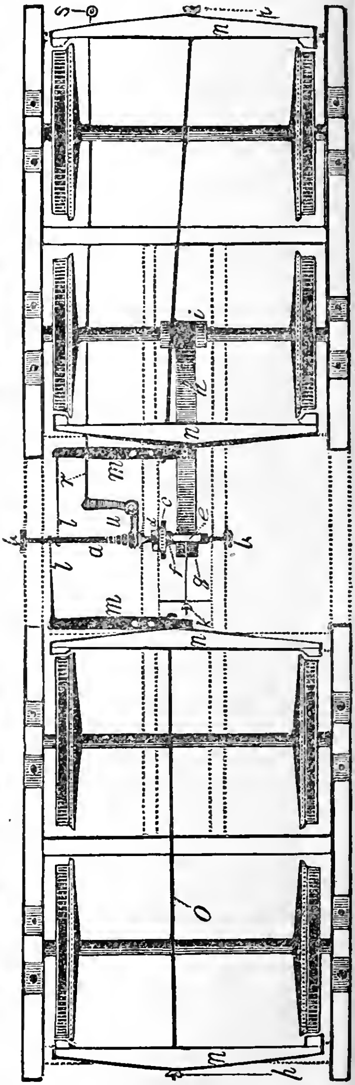


Fig. 1, is an elevation of an eight wheel car, with the *band and pulley brake*, attached. Fig. 2, an underside, or bottom, view of the brake.

a represents a shaft suspended to the body of the car by the boxes *b, b.*

a cog wheel which revolves on the shaft *a*, when not connected he clutch *d*.

a frame suspended on the shaft *a*, supporting the pinion of the ey *g*.

, a belt passing over the pulley *g*, and the axle of the car *i*.

, a tempering screw connected with the frame *e*, and with the body he car, to keep the belt sufficiently tight just to allow the car eels to turn, or to make them slide when the brakes are applied.

l, chains attached to the shaft *a*, and to the levers *m*, *m*, which d round the shaft *a*, when the wheel *c*, is connected by the clutch the shaft *a*.

n, *m*, levers connected to the brakes *n*, *n*, *n*, *n*, by the rods *o*, *o*, one end of which are the tempering screws *p*, *p*, to adjust the kes to the wheels, so that they shall cause them all to slide at the ie time.

ι, a forked lever supported by the frame of the car, to move the tch *d*, by means of the rod *r*, which is connected with the upright er *s*, the top of which is in the form of a T, to which is affixed es leading to the engine, by which the wheel *c*, may be clutched to shaft *a*, (the axle of the car acting on the pulley *g*, connected to pinion *f*, by the belt *h*,) and cause the chains *l*, *l*, to wind on the ıft *a*, and thus to draw on the levers *m*, *m*, which being connected th the brakes *n*, *n*, *n*, *n*, cause them to stop the revolution of all the ıeels.

'The advantages of this apparatus are, that the expense of brake-n may be saved, and the cars may be checked as soon as the engi-er, or any other person forward sees danger; and the apparatus is ıch more effectual for this purpose than brakemen, and the danger sing from brakemen jumping off, as they sometimes do, is avoided, d the train is stopped much more suddenly than by the brakemen, thout any shock, or strain; and in case of some cars of the train eaking loose, as they sometimes do, the lines may be so adjusted as ıt the lines for stopping the loose cars will, by the very circumstance their breaking loose, be drawn until they are parted, and the loose rs thus stopped, instead of drifting along the railway, as they some-ıes have done, to the great jeopardy of passengers.

"When the motion of the train is to be merely checked, but the train t stopped, the brakes of one or two cars, or more, that is to say as ıny as may be sufficient for the purpose, may be made to bear upon e wheels, the stopping of which, and their sliding on the rails, may sufficient to check the speed as much as may be desired.

"I claim as my invention, and the subject of a patent, the causing the revolution of the wheels to operate the brakes of railroad cars, the manner, and by the mechanical contrivance substantially the ne, and varying therefrom only in form; for the construction, as will evident to every mechanic conversant with the subject, may be ried in its form very much without any invention, or the introduc-ın of any new principle."

It appears from a number of testimonials of those who have used e foregoing brake, that it has fulfilled the intention of the patentee,

ters of reference, do not correspond with those of the specification drawings in the patent office, we give the following references to engravings, and also the concluding part of the specification.

Fig. 1.

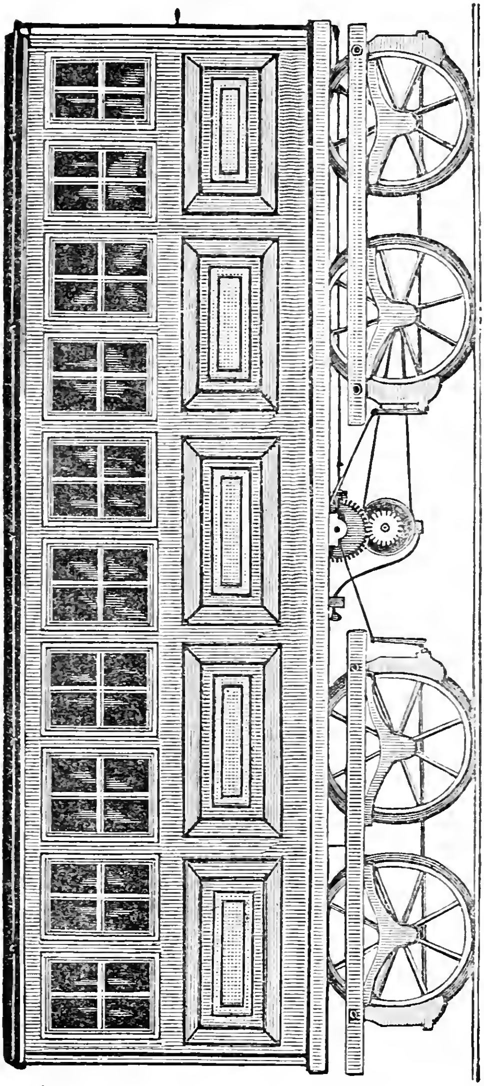


Fig. 2.

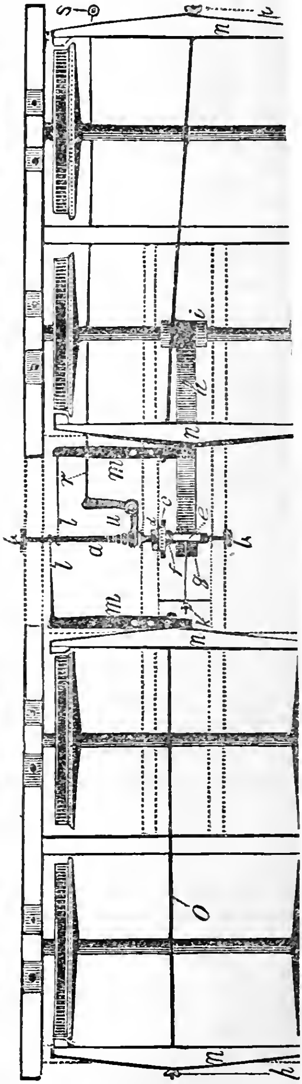


Fig. 1, is an elevation of an eight wheel car, with the *band a* *pulley brake*, attached. Fig. 2, an underside, or bottom, view of t brake.

a represents a shaft suspended to the body of the car by t boxes *b, b.*

c, a cog wheel which revolves on the shaft *a*, when not connected by the clutch *d*.

e, a frame suspended on the shaft *a*, supporting the pinion of the pulley *g*.

h, a belt passing over the pulley *g*, and the axle of the car *i*.

k, a tempering screw connected with the frame *e*, and with the body of the car, to keep the belt sufficiently tight just to allow the car wheels to turn, or to make them slide when the brakes are applied.

l, *l*, chains attached to the shaft *a*, and to the levers *m*, *m*, which wind round the shaft *a*, when the wheel *c*, is connected by the clutch on the shaft *a*.

m, *m*, levers connected to the brakes *n*, *n*, *n*, *n*, by the rods *o*, *o*, on one end of which are the tempering screws *p*, *p*, to adjust the brakes to the wheels, so that they shall cause them all to slide at the same time.

u, a forked lever supported by the frame of the car, to move the clutch *d*, by means of the rod *r*, which is connected with the upright lever *s*, the top of which is in the form of a T, to which is affixed lines leading to the engine, by which the wheel *c*, may be clutched to the shaft *a*, (the axle of the car acting on the pulley *g*, connected to the pinion *f*, by the belt *h*,) and cause the chains *l*, *l*, to wind on the shaft *a*, and thus to draw on the levers *m*, *m*, which being connected with the brakes *n*, *n*, *n*, *n*, cause them to stop the revolution of all the wheels.

"The advantages of this apparatus are, that the expense of brakemen may be saved, and the cars may be checked as soon as the engineer, or any other person forward sees danger; and the apparatus is much more effectual for this purpose than brakemen, and the danger arising from brakemen jumping off, as they sometimes do, is avoided, and the train is stopped much more suddenly than by the brakemen, without any shock, or strain; and in case of some cars of the train breaking loose, as they sometimes do, the lines may be so adjusted as that the lines for stopping the loose cars will, by the very circumstance of their breaking loose, be drawn until they are parted, and the loose cars thus stopped, instead of drifting along the railway, as they sometimes have done, to the great jeopardy of passengers.

"When the motion of the train is to be merely checked, but the train not stopped, the brakes of one or two cars, or more, that is to say as many as may be sufficient for the purpose, may be made to bear upon the wheels, the stopping of which, and their sliding on the rails, may be sufficient to check the speed as much as may be desired.

"I claim as my invention, and the subject of a patent, the causing of the revolution of the wheels to operate the brakes of railroad cars, in the manner, and by the mechanical contrivance substantially the same, and varying therefrom only in form; for the construction, as will be evident to every mechanic conversant with the subject, may be varied in its form very much without any invention, or the introduction of any new principle."

It appears from a number of testimonials of those who have used the foregoing brake, that it has fulfilled the intention of the patentee,

in a very satisfactory manner; we give, below, abstracts of four of these testimonials.

To Mr. G. S. Griggs,

For six months past, one of your band and pulley brakes has been in operation on a train of cars, of which I was engineer, on the Eastern Railroad, and I found it more effectual in stopping the progress of the train than any number of brakemen with the ordinary brakes. From the certainty of its operation I felt more confidence in being able to stop in case of difficulty, than with all others, with the complement of brakemen on a train. When moving at the rate of twenty-five miles an hour I could generally stop in the length of the train. Yours, &c.,

Henry Thomas, Engineer.

Newburyport, July 22nd, 1840.

To Mr. G. S. Griggs,

Dear Sir,—Your patent band and pulley brake has been in use on our road for the last two months. I have seen and examined the operation of it daily, and in my opinion it is the best brake that has ever been applied to railroads. The safety of its operation is of the greatest importance to the traveling public, &c. &c.

S. Huestis, Boston and Providence R. R.

July 25th, 1840.

Under date of July 25th, 1840, Mr. Warren certifies that having used this brake upon the Boston and Worcester Railroad, at intervals, for the last year, he has found its operation very powerful, and that he believes that it has saved him from contact with cattle, and other obstructions on the track, on curves of the road, where they could not have been seen in time to have succeeded with the ordinary brake.

Mr. Geo. S. Griggs,

Dear Sir,—I have been employed for the last six years by the Boston and Providence R. R. Co., the last four of which I have had charge of a Locomotive Engine. During this period I have used many kinds of brakes, but have never found any so effectual as your patent brake, and I hope to hear of its being generally adopted by railroad corporations, as in my opinion it is not only the safest but the least expensive of any brake ever applied to railroad cars.

Yours, &c.

July 30th, 1840. Leonard Crossman.

Bibliographical Notice.

"*Remarks on the Mineralogy and Geology of Nova Scotia. By* Abraham Gesner, Esq., *Surgeon.*"

The above is the title of an octavo volume of about 250 pages, which was published at Halifax, N. S., some time since, but which

has but recently fallen under our notice. Were our pen less occupied, we would enter into a more formal review of this work than it is our intention now to do, and, probably, the present brief notice will be all that most of our readers would desire, more especially as we are compelled, after perusing it with care, to say that we find but little in it that can entitle the author to any praise as a writer, on descriptive mineralogy and geology. He has, certainly, shown some industry in collecting facts, but this has been done with little apparent disposition to inform his readers whence they were obtained, as a large portion of the book has, manifestly, been derived from a previous publication on the same subject, by two gentlemen of Boston, Dr. Jackson and Mr. Francis Alger, whose memoir he has not merely adopted as his model, but, to no small extent, has appropriated as his own.

Our present task will consist, principally, in furnishing some brief extracts from the work, and of short notices where extracts would occupy too much room, upon which extracts and notices the reader may make his own comments, and if these should not be of a character tending to exalt the reputation of the author for acumen and judgment, he alone must be responsible for the decision.

At page 11, we are told that the boulders of granite (rocking stones) were placed in their "present uneasy positions" by a volcanic eruption, instead of having been left there by the gradual decomposition of the rock beneath them.

Page 13. We are informed that the "sublimed sulphur" adhering to the sides of the transition rocks, in the vicinity of Halifax, shows that these rocks have been exposed to intense heat. Now we think it most probable that the substance here spoken of, is some saline efflorescence; if it is not, it will be difficult to convince geologists that its origin can be explained in this way.

Page 13 again. We learn that of which we were not before aware, that *sulphuret* of alumina and potash, form common alum.

Page 24. Here we find mention of primary clay slate, of which, we will risk our reputation, there never has been found a particle in Nova Scotia. The writer confounds it with the transition clay slate.

Page 29. "Sulphate of lime owes its origin to an affinity existing between lime and sulphur." This is a new discovery in chemical science.

Page 32. It is asserted that the ore of iron, at Clements, could not have been rendered magnetic by the igneous trap, because this rock is of a much later date. What of that? Has not the trap sent out immense dykes, which may be now seen running through the slate? and how could they have found their way there without carrying heat with them?

Page 34. Crystals of smoky quartz from Bridgetown, in the primary form. We have a desire to see some of them, as all we have hitherto seen from that place, are far removed from rhomboids.

Page 35. Here quartz crystals are cited as evidence of the igneous origin of granite. If we had no *better* proof of the igneous origin of granite, the nepturists might grapple with us with some effect.

Page 42. The theory given of the formation of blue vitriol is quite new to us. We did not know before, that "the air" could decompose sulphate of copper, so as to set free the sulphuric acid.

Page 46. We are informed that care should be taken to avoid the sulphuret of iron, as this salt hastens its destruction, and renders it unfit for roofing slate. Here is a salt hitherto unknown in chemistry.

Page 49. How does the author distinguish between old and new red sandstone, near Kentrilla, where he says "they are in contact?" We are satisfied that they belong to one and the same formation, though modified, perhaps, by local causes.

Page 52. Trilobites with two or more lobes. Query, how many lobes has a *trilobite?*

Page 65. It is said that in every instance the transition clay slate is above the granite. Surely such a natural and undisputed fact as this did not require this statement, and should not cause any wonderment.

Page 123. Here we find an attempt to illustrate a passage of scripture, which illustration, we doubt not, has appeared to many quite original, and which, in justice to the author's talent as a biblical interpreter, as shown upon several of his pages, we shall lay before our readers, entire. "Who can clearly decide that the flaming sword which forever shut out our first parents from Eden's delightful garden, was not a livid torrent of flame, issuing from the ground polluted by sin."

Page 126. It is said that there are no extensive formations of oolite in Nova Scotia. It would have been better to have said plainly that there were none at all.

Page 140. The copper ore at Carriboo River, is not found in veins, but beds, and the author should know the difference between them.

Page 147. One would suppose that phosphate of lime and arragonite, could readily be distinguished from each other.

Page 178. "We have not been able to discover that any of the crystals of specular iron ore possessed polarity." Here surprize is expressed at not finding what no body ever saw or heard of. Specular iron possessing polarity! it is scarcely magnetic.

Page 199. Here we have an occasional variety of analcime (the flesh coloured) confounded with the sarcolite of Thompson, (which

is the octahedral Keuphone spar) and described as occurring in the form of the primary *cube*, or gradually passing into the trapezohedron. Now we much doubt whether analcime, in a form *short* of the *perfect* trapeschedron has ever been found in Nova Scotia. It is probable that a very obtuse form of rhombohedral carbonate of lime had been mistaken for analcime.

Page 202. The mineral here described as Prehnite, has been shown to be a botryoidal variety of chalcedony. We have a piece of the very substance in our possession, which had been labeled Prehnite, by Dr. Gesner, and which we received from a source that may be relied upon. Of course, his description of the mineral was copied from the books, without examining it for himself.

Page 214. We should like to be informed when Sir Howard Douglass took the altitude of the precipice near Cape Split? We are inclined to think that the author has misquoted from a certain book, in which it was stated that Messrs. Jackson and Alger determined the height of this precipice, by means of Sir Howard Douglass's Semi-Reflecting Circle.

Page 217. We are told that the magnetic iron ore from Cape Blomidon, will yield "eighty-five per cent. of pure iron." If this be true, the author has discovered a new oxide of iron, containing more atoms of metal than those already known; for we had supposed that seventy-two per cent was the maximum of metal that the purest ore could contain. We advise him to make known his discovery forthwith; but we fear that he has not yet "had an opportunity to analyze it."

Page 219. The discovery of a mineral hitherto unknown in Nova Scotia, is here announced, viz.

Leocite. This mineral, however mortifying the truth may be to the author, proves to be nothing but trapesohedral analcime. If he had had the "opportunity to analyze it," he would have found its composition to conform to the formula for analcime, containing water and soda, instead of potash.

Page 219. We should suppose that leocite, and Messrs. Jackson and Alger's new mineral (Ledemite,) could not be easily confounded, as the latter occurs only in regular hexahedral prisms.

Page 248. Crystals of albin in the form of the octahedron. We have some misgivings on this point.

We have thus given the reader some idea of the character of this treatise on the mineralogy and geology of Nova Scotia, by a gentleman who has the reputation of being a man of science, and who has appeared before the public as a lecturer on chemistry, mineralogy, and geology. We think the references we have made, show, most

clearly, that at the time of writing the book, whatever may have been his attainments since, his knowledge of individual minerals was such that little dependence could be placed upon his descriptions, and that he betrayed his ignorance of some of the fixed principles of geology and chemistry. We could give other proofs of these assertions, should they be desirable; these are such as presented themselves in casually looking through the book. We will further observe, that a large number of the localities referred to, are not to be found in the map accompanying the work, and that the colouring of the map is by no means correct, though its principal and most accurate features have been copied (perhaps we ought to use a stronger word,) from the map prepared and published by Messrs. Jackson and Alger, who personally examined the same region several years before the publication by Dr. Gesner, and from whom, in other places, he has borrowed very liberally, with but a very summary and inadequate acknowledgment. Halifax itself, is represented as standing on primitive rock; and primitive, or granite, is the colouring given for nearly the whole formation of transition slate and quartz rock, when, in fact, the granite should be represented only in patches, here and there, as it happens to protrude itself through the slate.

Progress of Practical & Theoretical Mechanics & Chemistry.

Corrosion of Cast and Wrought Iron in Water. By Robert Mallet, A. I. C. E.

CONTINUED FROM PAGE 128.

The author next proceeds to the important question of the protection afforded by paints and varnishes. White lead perishes at once in foul water, both fresh and salt; caoutchouc dissolved in petroleum appears the most durable in hot water, and asphaltum varnish or boiled coal tar laid on while the iron is hot, under all circumstances. The zinc paint, which is now so much noticed as an article of commerce, the author has analysed, and states its composition as—

Sulphuret lead,	9.05
Oxide zinc,	4.15
Metallic zinc,	81.71
Sesqui oxide iron,	0.14
Silica,	1.81
Carbon,	1.20
Loss,	1.94
	100.

It may, *à priori*, be considered likely to produce a most excellent body for a sound and durable paint under water. The black oxide of manganese has no advantages but that of being a powerful drier. The defects of all oil paints arise from the instability of their bases;

the acids which enter into the constitution of all fixed oils readily quit their weakly positive organic bases to form salts with the oxides of the metel on which they may be laid. Hence we must look for improvements in our paints to those substances among the organic groups which have greater stability than the fat or fixed oils, and which, in the place of being acid, or haloid, are basic or neutral. The heavy oily matter obtained from the distillation of resin, called "resenien," and eupion, obtained from rapeseed oil, have valuable properties as the bases of paints.

Tables IX and X contain the results as to the corrosion of cast-iron in sea water when exposed in voltaic contact with various alloys of copper and zinc, copper and tin, or either of these metals separately, per square inch of surface. It appears that neither brass nor gun metal has any electro-chemical protective power over iron in water, but, on the contrary, promotes its corrosion. This question is only a particular case of the following general question—viz: if there be three metals, A, B, C, whereof A is electro-positive, and C electro-negative, with respect to B, and capable of forming various alloys, 2 a + C.... A + C....A + 2C; then if B be immersed in a solvent fluid in the presence of A, B will be electro-chemically preserved, and A corroded, and *vice versa.* If B be so immersed in the presence of C, B will be dissolved or corroded, and C electro-chemically preserved—the amount of loss sustained in either case being determined according to Faraday's "general law of volta-equivalents." The tables show that the loss sustained by cast iron in sea water, as compared with the loss sustained by an equal surface of the same cast iron in contact with copper, is 8.23 : 11.37 ; and when the cast iron was in contact with an alloy containing seven atoms of copper and one of zinc, the ratio was 8.23 : 13.21 ; so that the addition in this proportion of an electro-*positive* metal to the copper produces an alloy (a new metal, in fact) with higher electro-negative powers, in respect to cast iron, than copper itself. The author discusses many results equally remarkable, and is, therefore, enabled to suggest, by its chemical notation, the alloy of "no action," or that which in the presence of iron and a solvent would neither accelerate nor retard its solution, one of the components of this alloy being slightly electro-negative, and the other slightly electro-positive, with respect to cast iron. These results will also enable some advances to be made towards the solution of the important problem proposed by the author in his former report—viz : "the obtaining a mode of electro-chemical protection, such that while the metal (iron) shall be preserved, the protector shall not be acted on, and the protection of which shall be invariable."

Table X exhibits especially the results of the action of sea water on cast iron in the presence of copper and tin, or their alloys. It appears that copper and tin being both electro-negative with respect to cast iron, all their alloys increase or accelerate the rate of corrosion of cast iron in a solvent, though in very variable degrees; the maximum increase is produced by tin alone, thus indicating that this metal (contrary to what was previously believed) is more electro-negative to cast iron than copper. Hence the important practical deduction, that,

where submerged, works in iron must be in contact with either alloy—viz: brass or gun metal; common brass, or copper and zinc, is much to be preferred. These experiments will also serve to demonstrate the fallacy from many of the patented so-called preservatives of oxidation, which are brought before the public with so much parade.

The author, lastly, proceeds to the subject of the specific gravity of cast iron, tables of which are added to the preceding. The specific gravities here recorded were taken on equal sized cubes of the several cast irons cut by the planing machine, from bars of equal size, cast at the same temperature, in the same way, and cooled in equal times. Many of these results differ considerably from those given by Dr. Thompson and Mr. Fairbairn; which the author refers to the probability that those of Dr. Thompson were taken from pieces of the raw pig, and those of Mr. Fairbairn by weighing in air equal bulks cut from the mass by the chisel and file, by which latter process the volume is liable to condensation. The experiments of Mr. Fairbairn and Mr. Eaton Hodgkinson seem to show that the ultimate strength of cast iron is in the ratio of some function of the specific gravity dependent upon the following conditions—viz: 1. The bulk of the casting; 2. The depth or head of metal under which the casting was made; 3. The temperature at which the iron was poured into the mould; 4. The rate at which the casting was cooled.

Table XI. All the irons experimented on are arranged in classes, according to the character of the fracture; for which purpose the terms—1. Silvery, 2. Micaceous, 3. Mottled, 4. Bright grey, 5. Dull grey, and 6. Dark grey, have been adopted by the author as a sufficient basis on which to rest a uniform system of nomenclature for the physical characters of all cast irons, as recognisable by their fracture; and it is to be wished that experimenters in future would adopt this or some other uniform system of description, in place of the vague and often incorrect characteristics commonly attached to the appearance of the fracture of cast iron.

The twelfth and last table contains the results of a set of experiments on the important subject of the increase of density conferred on cast iron, by being cast under a considerable head of metal, the amount of which condensation had not been previously reduced to numbers. It shows an increase of density in large castings, for every two feet in depth, from two to fourteen feet deep of metal.

A very rapid increase of density takes place at first, and below four feet in depth a nearly uniform increment of condensation.

The importance of these results is obvious; for, if the ultimate cohesion of castings is as some function of their specific gravity, the results of experiments in relation to strength, made on castings of different magnitudes, or cast under different heads, can only be made comparable by involving their various specific gravities in the calculation.

Mining Jour. Nov. 1840.

Electric Telegraph.

This extraordinary machine is now being worked on the Great Western Railroad, between Drayton and Paddington; and, though no distinct idea of the apparatus can be imparted without plates and draughts of the dial, pipes, rods, &c., of which it is composed, yet the principle will excite unqualified admiration when our readers learn that intelligence is conveyed at the rate of 200,000 miles per second, or 8000 times quicker than light travels during the same period, by means of electrical currents passing through coils of copper wire, placed immediately behind some fine magnetic needles, made to operate upon a circular series of twenty letters, which indicate such terms, either separately or collectively, as they have been arranged to represent. This telegraph will act both day and night, in all states of the weather, and with a rapidity so superior to the common process, that one minute only is required for the communication of thirty signals.

Ibid., August, 1840.

On the Composition of Crystallized Phosphoric Acid. By M. Eugene Peligot. Acad. des Sciences, 4th May, 1840.

M. Peligot refers to the experiments of M. Graham upon the combinations of phosphoric acid with water, and quotes the passage in which he supposes the existence of three compounds of this acid, with one, two, and three atoms of water respectively. He then gives an account of some experiments which he has recently made upon some crystaline substances found in bottles of phosphoric acid, which had been preserved for some years. The analyses of these crystals prove them to be compounds of phosphoric acid, respectively with three and two atoms of water, (PhO^5, 2HO and PHO^5, 3HO.)

Annales de Chimie et de Physique, March, 1840.

Memoir on the Examination for Arsenic in Judicial Inquiries. By M. L. Figuier.

After remarking upon the inconveniences which attend the use of Maesh's apparatus and its modifications by Liebig, Berzelius, Chevalier, and Orfila, M. Figuier traces the plan by which he proposes to avoid these evils.

The suspected matters are first cut into pieces, and boiled for four or five hours in water, a slight alkaline re-action being maintained in the liquid.

When cold, the fatty matters which swim on the surface are separated, and the liquid filtered.

The filtered liquid is then slightly acidulated by hydrochloric acid, evaporated to dryness, and the residuum dried but not carbonized.

It is then redissolved in warm water, and filtered to separate the deposit caused by desiccation.

The brown liquid thus obtained is submitted to a current of washed chlorine gas, until it ceases to be rendered turbid by the gas. The precipitate is again separated by filtration, and the liquid boiled in a porcelain capsule to expel the chlorine. The liquid is then introduced into a modification of Marsh's apparatus.

This consists of a flask closed by a cork, which is traversed by two tubes, one of which terminates at its upper extremity in a funnel, and descends to near the bottom of the flask. The other is a bent tube of about one-fourth of an inch in diameter, and drawn out at its extremity. In the horizontal part are placed some pieces of fused chloride of calcium, and farther on some fragments of porcelain; to this latter part of the tube the heat is to be applied.

About fifty grammes of zinc are placed in the flask, and the cork being put in place, sulphuric acid diluted with seven times its weight of water is poured in by the funnel tube. Hydrogen is formed which drives out the air from the apparatus. When the disengagement of the gas has gone on sufficiently long to avoid the danger of an explosion, that portion of the tube which contains the porcelain is heated to redness, and then the decoction, prepared as above, is poured into the flask. If the mixture in the flask foams so much as to be likely to enter the tube, five or six grammes of alcohol poured in through the funnel will check it instantly.

If the liquid examined contain any traces of arsenical poison it will soon shew itself at a short distance from the point heated red hot, and in the part of the tube drawn out, as a small brilliant circle of metallic arsenic, which augments as the operation proceeds; when this ceases to increase, the operation, which should last one or two hours, is stopped. The tube is cooled and separated from the rest of the apparatus. The characters of the metal may then be tested without injury to its metallic appearances. Finally the tube is hermetically closed at both ends, by the lamp, and preserved to be produced in court.

Journal de Pharmacie, October, 1840.

A New Blue Ink prepared from Prussian Blue.

Saturate with care, pure Prussian blue, with one-sixth of oxalic acid, and a little water, so as to form a paste, which is free from clots. It is then diluted with rain water until the desired shade is obtained, which is told by trying it upon white paper.

The colour is extremely deep; if the liquor is but slightly diluted, the writing appears perfectly black, and gives, upon drying, a copper lustre. By dilution the most beautiful shades are produced, even to the brightest azure. A slight addition of gum thickens the ink and prevents it from soaking through thin paper. Of course this ink is not indestructible; caustic potassa, hydrochloric acid, and water remove it. Messrs. Stephen and Nash have taken out a patent for it in England.

Ibid.

On a New Alum. *By* Dr. Mohr.

For sometime past there has been introduced into the German market an alum said to contain, in a state of great concentration, the principles which are principally active in dyeing and printing. This quality, it is said, renders its employment more advantageous, and diminishes considerably the expense of transportation. This alum has not the least resemblance to the ordinary potash alum, for it presents no trace of crystallization, but is in flat quadrangular plates, about an inch thick; it is white, feebly transparent, and dissolves very easily in water; its taste is sweetish, bitter, and aluminous, but much less stong than that of ordinary alum. If pulverized sulphate of potassa is thrown into a concentrated solution of this alum, a crust of common alum forms directly. Mr. Mohr has found its composition to be,

Alumina, - -	13.91
Sulphuric acid, -	36.24
Potassa, - - -	1.50
Water, - -	49.60

We see by this composition that the alum in question is, properly speaking, but a pure sulphate of alumina with eighteen atoms of water of crystallization. A compound mentioned by Berzelius in his Traitè de Chimie, and which in 100 parts contains 48.53 water of crystallization. It is probably prepared from pipe-clay, calcined and pulverized, and sulphuric acid not entirely concentrated; the mixture is boiled to dryness in appropriate vessels, by a strong fire, whence its peculiar non-crystalline appearance. This new alum is altogether free from iron, and replaces the ordinary alum in all its uses; but it is for the preparation of the mordant, acetate of alumina, that it offers the most essential advantage. In fact, as it contains scarcely any sulphate of potassa, one fourth the quantity of acetate of lead is saved in its decomposition by that salt, since the ordinary alum contains three atoms of sulphate of alumina and one of sulphate of potassa. Ibid.

Mechanics' Register.

Power of Steam.—The greatest load lifted by any engine now at work in this country was by one in the Consolidated Mines, which raised a load of 9000 lbs. every double stroke it made, and did this nine times a minute, amounting to 267,022 tons, lifted seven feet six inches in twenty-four hours; and this astonishing machine could be started, stopped, or regulated, by a little boy.

Mining Jour. July 1840.

Salt Mine in Switzerland.—A salt mine has been discovered at Rheinfelden, in the canton of Argau, which the Swiss papers expect will be sufficiently abundant to supply all Switzerland, and thus save to the Confederation the 500,000 francs annually drawn from it for the purchase of foreign salt.—*Galignani's Messenger.*

Ibid. Aug. 1840.

Capital of Great Britain.—The grand total capital represented by all property in Great Britain and Ireland is estimated at 3,629,000,000*l.* The value of all sorts of public property is 103,000,000*l.* The value of lands, ships, canals, rail-roads, mines, horses, cattle, timber, crops, &c., is estimated at 2,945,000,000*l.* The value of all sorts of furniture, apparel, plate, specie, money in chancery, savings' banks, &c., is estimated at 580,000,000*l.* The national debt is about 764,000,000*l.*

Ibid, 1840.

Spontaneous Gas Company.—The directors of this company are actively prosecuting their unprecedented project. Pipes are casting, and ere many weeks have passed away, the Newcastle and North Shields railway will, in all probability, be lighted from the great natural reservoir of gas at Wallsend.—*Northern Times.*

Ibid, September, 1840.

French Steam Engines.—There are in France 950 steam engines, 719 French, 144 foreign, and 87 of unknown origin. Of 863 engines of known origin, 334 are low pressure, and 429 high pressure.

Ibid, 1840.

Meteorological Observations for January, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	22	23	29 93	29.50	E.	Brisk.	.85	Cloudy—snow and hail.
	2	16	28	.40	.45	W.	Moderate.		Clear—clear.
	3	4	6	.70	.75	W.	Brisk.		Clear—clear.
	4	4	19	30.05	30.06	W.	Calm.		Clear—lightly cloudy.
	5	14	25	.30	.33	E.	Mod-rate.		Cloudy—cloudy.
	6	35	36	.15	.75	E.	do	1 20	Rain—rain.
☉	7	51	55	29 90	29 80	S.	Brisk.	1.00	Cloudy—rain.
	8	39	48	.90	.90	W.	Moderate.		Clear—clear.
	9	32	42	.95	30.00	W.N.	do.		Clear—lightly cloudy.
	10	33	36	30.00	.00	E.N.E.	do.		Cloudy—drizzle.
	11	38	44	29 80	29 70	E.	do.		Rain—rain.
	12	37	45	.96	.96	W.	do.		Clear—clear.
	13	33	34	30.10	90	E.	do.	.70	Snow—snow.
☽	14	32	32	.00	30 10	E.	do.		Cloudy—cloudy.
	15	20	33	.05	05	E.	do.	.15	Fog—fog.
	16	30	37	.23	.23	W.	Brisk.		Drizzle—cloudy.
	17	33	44	29 75	29.65	S.W.W.	Calm.	.60	Rain—cloudy.
	18	17	16	30 10	.90	W.	Moderate.		Clear—lightly cloudy.
	19	8	15	.50	30.53	N.W.	do.		Clear—hazy.
	20	18	29	.50	.40	N.E.	do.	.45	Snow—snow.
	21	32	36	29 80	29.74	N.E.	do.	1.05	Sleet—drizzle rain in night.
⊗	22	33	33	.80	.84	W.	do.	.15	Cloudy—cloudy.
	23	26	32	.75	.76	W.	do.		Cloudy—partially cloudy.
	24	30	44	.83	.75	S E.E.	do.		Cloudy—lightly do.
	25	31	43	.70	.70	W	do.		Clear—clear.
	26	26	46	30.10	30.15	W.	do.		Clear—do.
	27	36	42	29 85	2 50	S.W.W.	do.	.03	Cloudy—cloudy.
	28	33	46	30 15	30.10	W.	do.		Clear—cloudy.
	29	34	34	.[illegible]0	29 90	E.	do.	.38	Rain—rain.
	30	32	40	29 90	95	W.	do.		Partially cloudy.
☾	31	28	41	30 00	.96	W.	do.		Partially cloudy—cloudy.
	Mean	27.97	34.97	29.98	29.94			6.56	

	Thermometer.		Barometer.	
Maximum height during the month,	55 00	on the 7th.	30.75	on the 6th.
Minimum " "	4 00	on the 3rd and 4th.	29.40	" 2nd.
Mean	31.47		29.96	

W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
·	1⅔	⅔	3⅔	⅓	·	5⅓	....	·	....	....	·	1183
·	·	1	4⅔	⅔	·	⅔	....	·	....	....	·	1276
·	2	·	4	·	·	4	....	·	....	....	·	1200
⅔	10⅔	·	2	·	·	8	....	·	....	....	·	1195
1⅓	3⅓	·	3	·	1	·	57.55	·	....	68.32	·	1194
3⅓	7⅔	⅓	2⅓	·	2	1	....	·	....	....	·	1206
·	3	4	9⅓	·	·	·	....	·	....	....	·	1184
·	4⅓	·	3	·	·	·	....	·	....	....	·	1311
⅓	⅓	·	3⅓	1	1⅓	⅔	65.07	·	....	....	·	1209
1	3	1	2	⅔	·	⅓	64.46	2	....	71.98	2	1193
·	5	·	7⅔	·	·	·	62.43	3	....	....	·	1185
⅓	5	·	3	⅓	2	·	....	·	....	72.26	·	1186
·	⅔	·	2	·	14⅓	5⅓	....	·	....	....	·	1189
⅔	3⅓	⅔	⅔	⅔	7	·	....	·	....	....	·	1213
·	18⅔	·	·	·	·	·	....	·	....	....	·	1215
⅓	4	·	4⅓	·	4⅔	10⅓	....	·	....	....	·	1190
·	20⅔	·	·	·	⅓	1	....	·	....	71.71	·	1211
1⅔	11⅓	1	2⅓	·	5⅓	2⅔	....	·	....	...	·	1197
4⅔	1⅓	6	2⅓	·	·	⅓	....	·	....	....	·	1191
3⅓	4⅔	⅔	1⅓	·	12⅔	1	....	·	....	....	·	1210
·	7	·	1⅔	·	11⅔	·	....	·	...	....	·	1201
·	1⅓	⅓	1⅓	·	14⅔	6⅔	....	·	....	....	·	1208
·	·	·	12	·	·	1	....	·	....	....	·	1202
·	4	·	3	·	1	·	....	·	....	....	·	1270
·	7	·	2⅓	·	⅔	8	65.21	15	....	71.13	16	1197
·	19⅓	·	⅔	·	·	·	....	·	....	....	·	1198
·	7	·	2⅓	·	1	3	....	·	....	....	·	1199

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
AUGUST, 1840.

County.	Town.	Observer.	Thermometer. 7, A. M.	Thermometer. 2, P. M.	Thermometer. 9, P. M.	Thermometer. Maximum.	Thermometer. Minimum.	Thermometer. Mean.	Thermometer. Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.	Barometer. 7, A. M.	Barometer. 2, P. M.	Barometer. 9, P. M.	Barometer. Maximum.	Barometer. Minimum.	Barometer. Mean.	Barometer. Days omitted.	Weather. Clear.	Weather. Cloudy.	Weather. Days omitted.	Weather. Rain.	Weather. Snow.	Weather. Rain and Snow.	Weather. Thunder Showers.	Weather. Rain in inches.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia, .	Philadelphia, .	J. M. Hamilton, .	74.47	78.85	70.96	86.00	66.00	74.76	3	60.00	64.17	3	30.11	30.09	30.08	30.45	29.79	30.09	2⅓	24⅔	3⅔	2⅔	....	....	....	..	...	⅔	⅔	1⅓	.	2⅓	⅓	3⅔	1	3⅓	1⅓	4⅔	.	1⅔	⅔	3⅔	⅓	.	5½	....	.	.....	....	.	1163
2 Montgomery, .																																																			
3 Bucks, .	Newtown, .	L. H. Parsons, .	71.63	80.67	66.30	88.00	47.00	72.87	.	51.00	59.32	.	30.01	29.99	29.97	30.35	29.71	29.99	.	19⅓	8⅓	3⅓	9	....	....	2	5.549	.	1	1⅔	⅔	⅔	.	2⅓	⅓	2⅓	⅓	14⅔	.	.	1	4⅔	⅔	.	⅔	....	.	.....	....	.	1275
4 Lehigh, .																																																			
5 Northampton,	Easton, .	Charles Elliot, .	65.74	70.00	67.57	83.00	57.00	67.77	1	....	....	.	29.93	29.91	29.91	30.30	29.59	29.92	3⅓	.	.	.	....	....	....		.....	.	.	1⅓	.	1⅓	.	2⅔	.	.	.	15⅔	.	2	.	4	.	.	4	....	.	.....	....	.	1200
6 Monroe, .	Stroudsburg, .	A. M. Stokes, .	66.65	81.05	70.20	88.00	50.00	72.63	11⅓	....	....	.	29.58	29.60	29.55	29.90	29.25	29.58	9⅓	6	14⅓	10⅔	....	....	....		2.740	.	.	.	.	.	.	2⅓	.	6	.	1	⅔	10⅔	.	2	.	.	8	....	.	.....	....	.	1195
7 Pike, .	Milford, .	Ralph Bull, .	60.80	78.90	62.50	87.00	51.00	67.40	.	50.00	57.68	.	29.58	29.55	29.57	29.93	29.23	29.57	.	16⅔	14⅓	.	....	....	....	..	......	1⅓	.	1⅓	.	2⅓	⅓	1⅔	1	5	1⅓	7⅓	1⅓	3⅓	.	3	.	1	.	57.55	.	.....	68.32	.	1194
8 Wayne, .	Honesdale, .	W. Richardson, .																																																	
9 Susquehanna,	Silver Lake, .	E. Rose, .																																																	
10 Luzerne, .	Wilkesbarre, .	W. F. Dennis, .																																																	
11 Schuylkill, .	Port Carbon .	John G. Hewes, .	64.27	80.81	66.25	90.00	54.00	70.44	1	52.00	60.30	1	29.35	29.34	29.36	29.98	29.04	29.35	1	12⅔	17⅓	1	8	....	....	..	5.540	⅓	.	1	.	2⅔	⅓	4⅓	.	1⅓	.	4	3⅓	7⅔	⅓	2⅓	.	2	1	....	.	.....	....	.	1206
12 Berks, .	Reading, .	C. F. Egelmann, .	69.10	73.06	68.35	84.00	60.00	71.84	.	...	...	.	29.88	29.87	29.86	30.20	29.50	29.87	.	18	13	.	....	....	....	..	3.377	.	.	.	.	⅓	.	3⅓	.	4	⅓	6⅔	.	3	4	9⅓	.	.	.	....	.	.....	....	.	1184
13 Chester, .	West Chester,	Wm. W. Jefferies, .	72.46	80.38	76.92	87.25	65.00	76.59	.	59.50	69.40	.	30.64	30.64	30.64	30.84	30.40	30.64	.	.	.	.	....	....	....	..	......	1	.	2	.	2⅓	.	3⅔	.	6⅔	.	8	.	4⅓	.	3	.	.	.	....	.	.....	....	.	1311
14 Delaware, .	Haverford, .	Haverford School, .	69.87	79.68	68.06	86.00	60.00	72.54	⅓	54.00	60.30	⅓	29.56	29.56	29.56	29.90	29.25	29.56	7	15	9	7	9	....	....	..	3.658	⅔	1⅔	1	.	⅓	⅓	1⅔	⅓	1⅓	4⅔	11⅓	⅓	⅓	.	3⅓	1	1⅓	⅔	65.07	.	.....	....	.	12[illegible]9
15 Lancaster, .	Lancaster, .	Conservatory of Arts,	69.15	81.57	70.61	89.00	59.50	73.78	⅔	55.00	65.99	.	29.52	29.50	29.51	29.87	29.15	29.51	⅔	18	12⅔	⅓	8	....	....	..	3.010	2⅓	.	1	.	1⅓	1⅓	2⅓	2⅓	7	2	3	1	3	1	2	⅔	.	⅓	64.46	2	.....	71.98	2	1193
16 York, .																																																			
17 Lebanon, .																																																			
18 Dauphin, .	Harrisburg, .	J. Heisely, .	71.65	79.90	75.94	86.00	64.00	75.83	.	60.00	68.35	.	29.75	29.73	29.71	30.05	29.42	29.73	.	20	11	.	9	....	....	7	3.522	1⅓	.	.	.	.	.	5⅔	.	3⅓	.	8	.	5	.	7⅔	.	.	.	62.43	3	.....	....	.	1185
19 Northumberland,	Northumberland,	Andrew C. Huston,	68.68	77.44	70.77	85.00	60.00	72.30	.	49.00	59.23	.	29.49	29.47	29.47	29.84	29.15	29.47	.	9⅔	21⅓	⅓	9	....	....	5	6.012	2⅓	.	3⅔	.	⅔	⅓	3	.	9	.	1	⅓	5	.	3	⅓	2	.	....	.	.....	72.26	.	1186
20 Columbia, .	Danville,	C. H. Frick,																																																	
21 Bradford, .																																																			
22 Tioga, .																																																			
23 Lycoming, .																																																			
24 Union, .																																																			
25 Mifflin, .																																																			
26 Juniata, .	Mifflintown, .	J. A. Rinkead, .	61.94	81.63	66.94	92.00	53.50	70.17	5⅓	....	....	.	29.51	29.43	29.49	29.84	29.16	29.48	5⅔	10	14⅔	6⅓	....	....	....	..	......	⅓	.	1⅓	.	⅓	.	2⅓	.	.	.	4	.	⅔	.	2	.	14⅓	5⅓	....	.	.....	....	.	1159
27 Perry, .																																																			
28 Cumberland, .	Carlisle,	Prof. W. H. Allen,																																																	
29 Adams, .	Gettysburg, .	Prof. M. Jacobs, .	67.39	80.58	70.35	86.50	59.00	72.77	.	51.00	62.55	.	29.43	29.40	29.41	29.73	29.13	29.42	.	20	11	.	11	....	....	1	2.901	2⅓	.	.	.	.	.	2⅓	⅓	7⅔	2⅓	3	⅔	3⅓	⅔	⅔	⅔	7	.	....	.	.....	....	.	1213
30 Franklin, .																																																			
31 Huntingdon, .	Huntingdon, .	Jacob Miller, .	67.87	83.03	69.45	91.00	55.00	73.45	.	....	....	.	29.38	29.35	29.36	29.69	29.08	29.36	.	25	6	.	8	....	....	..	3.442	.	.	.	.	12⅓	.	.	.	.	.	.	.	18⅔	.	.	.	.	.	....	.	.....	....	.	1215
32 Centre, .	Bellefonte, .	John Harris, .	63.83	78.97	66.96	86.50	52.50	69.92	7	....	....	.	29.30	29.31	29.38	29.64	29.01	29.30	7⅓	10⅔	12⅔	7⅔	5	....	....	..	6.086	2⅔	.	.	.	⅔	⅔	1⅓	⅓	1⅓	.	2⅓	⅓	4	.	4⅓	.	4⅔	1[illegible]⅓	....	.	.....	....	.	1190
33 Potter, .																																																			
34 M'Kean, .	Smithport, .	Richard Chadwick,	61.23	75.55	56.87	86.00	48.00	64.55	.	41.00	53.00	.	28.06	28.07	28.03	28.25	27.80	28.05	.	7⅔	23⅓	.	8	....	....	..	5.095	.	.	.	.	⅓	.	1	.	.	.	7⅔	.	20⅔	.	.	.	⅔	1	....	.	.....	71.71	.	1211
35 Clearfield, .																																																			
36 Cambria, .	Ebensburgh, .	Richard Lewis, .	63.13	76.72	62.87	86.00	49.00	67.57	2⅔	41.00	56.45	2	27.96	27.93	27.94	28.22	27.70	27.94	2⅔	9⅔	16⅔	4⅔	5	....	....	2	2.962	.	.	.	.	.	.	2	.	2⅓	.	2⅓	1⅔	11⅓	1	2⅓	.	5⅓	2⅔	....	.	.....	....	.	1197
37 Bedford, .	Bedford, .	Samuel Brown, .	70.87	78.68	74.15	87.20	60.50	74.57	.	....	....	.	29.26	29.24	29.26	29.55	28.98	29.26	.	19	12	.	....	....	....	..	......	.	.	.	.	.	.	1⅔	3⅔	⅓	1⅔	9	4⅔	1⅓	6	2⅓	.	.	⅓	....	.	.....	....	.	1191
38 Somerset, .	Somerset, .	George Mowry, .	63.65	73.52	63.64	82.00	52.00	66.94	.	46.00	58.34	.	28.00	28.00	28.00	28.29	27.75	28.00	.	12⅓	18⅔	.	3	...	....	6	3.407	.	.	.	.	.	.	1⅔	1⅓	⅔	.	4⅔	3⅓	4⅔	⅔	1⅓	.	12⅔	1	....	.	.....	....	.	1210
39 Indiana, .	Indiana, .	Richard White, .	72.94	77.74	66.00	85.00	58.00	72.23	.	39.00	49.87	.	28.68	28.67	28.65	29.00	28.40	28.67	.	14⅓	16⅔	.	5	....	....	5	4.220	.	.	.	.	.	.	5⅓	.	2⅔	.	2⅔	.	7	.	1⅔	.	11⅔	.	....	.	.....	....	.	1201
40 Jefferson, .	Rose Cottage, .	C. C. Gaskell, .																																																	
41 Warren, .	Warren, .	C. S. Brown, .	65.82	73.62	71.38	82.00	55.00	70.27	6⅔	55.00	65.25	7	28.83	28.81	28.83	29.20	28.58	28.82	6⅔	15⅓	9	6⅔	....	....	...	..	......	⅓	.	⅓	.	.	.	⅔	⅓	.	⅔	4⅓	.	1⅓	⅓	1⅓	.	14⅔	6⅔	....	.	.....	....	.	1208
42 Venango, .	Franklin, .	Wm. Connely, .	59.97	82.81	68.26	94.00	48.00	70.35	.	....	....	.	29.10	29.11	29.04	29.90	28.60	29.08	1⅓	16⅓	13⅓	1⅓	10	....	....	..	5.560	.	.	.	.	.	.	13⅓	.	.	.	4⅔	.	.	.	12	.	.	1	....	.	.....	....	.	1202
43 Armstrong, .																																																			
44 Westmoreland,																																																			
45 Fayette, .	Uniontown, .	J. P. Weithers, .	68.87	83.58	69.34	94.00	54.00	73.93	.	....	....	.	28.99	29.00	29.01	29.30	28.68	29.00	.	24⅔	6	⅓	....	....	....	..	......	1	.	.	.	.	.	2⅔	.	3⅓	.	16	.	4	.	3	.	1	.	....	.	.....	....	.	1270
46 Green, .																																																			
47 Washington, .	Cannonsburg, .	A. H. Campbell, .	66.29	78.78	70.13	86.00	52.00	71.73	.	49.00	61.03	.	29.10	29.07	29.09	29.36	29.87	29.09	.	5	8	18	9	....	....	..	3.065	⅓	.	1⅔	.	2	.	2	.	⅔	.	6⅓	.	7	.	2⅓	.	⅔	8	65.21	15	.....	71.13	16	1197
48 Alleghany, .	Pittsburgh, .																																																		
49 Beaver, .	Beaver, .	Wm. Allison, .																																																	
50 Butler, .	Butler, .	Jacob Mechling, .	66.26	77.48	71.32	86.00	52.00	71.69	.	....	....	.	28.84	28.84	28.84	29.10	28.60	28.84	.	.	.	.	9	...	....	2	6.590	.	.	.	.	6	.	⅔	.	1⅓	.	3	.	19⅓	.	⅔	.	.	.	....	.	.....	....	.	1198
51 Mercer, .	West Greenfield,	S. Campbell, .																																																	
52 Crawford, .	Meadville, .	J. Limber, .	68.97	77.21	68.48	92.00	60.00	71.55	1⅔	52.00	66.62	2	28.78	28.78	28.77	29.08	28.53	28.78	2	12⅓	16⅓	2⅓	9	....	....	2	7.801	2	.	.	.	⅓	.	1⅓	⅓	8	⅔	5	.	7	.	2⅓	.	1	3	....	.	.....	....	.	1199
53 Erie, .	Erie, .	Park & Reid, .																																																	

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

APRIL, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 154.]

No notice has been taken in the foregoing of the effect of the quantity of water delivered upon the velocity, the means having been deduced from all the apertures under a given head.

The velocity is, however, increased under a given head by an increase of quantity, a fact of the more importance because the velocity may be then increased without lessening the ratio of effect to power. The amount may be deduced from the following table.

TABLE ELEVENTH.

Showing the velocity of the wheel with different widths of aperture. Overshot No. I. Taken from tables first and third.

Width of aperture.	Velocities for maximum effects with heads of 2.75	2.25	1.25	1.25	0.75	Mean velocity.
Inches.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
0.50	5.28		4.65			4.96
0.75		5.21	4.77			4.99
1.00	5.43	6.01	5.28			5.57
1.25	5.58	5.50	4.83	6.20	4.77	5.38
1.50				6.10	5.07	5.58

It is obvious that if in the above table the columns for each head were filled, the relation shown by the mean would be independent of the head. Although this is only partially true in the present case we are warranted by the general examination of the results for each head, and then by the average, in concluding that a slight increase of velocity results from increased quantity, the head remaining the same. If the mean could be implicity trusted it would prove a tendency towards a maximum, by its slow increase. The quantity being tripled, the increase of velocity is thirteen per cent., increasing from 1.00 to 1.13. This, as has been before shown, is with the buckets less than three-tenths full. If the quantity were much increased, other circumstances would become operative.

The fact just presented will be useful in practice where water is plenty, and it is desirable to have a particular velocity for the periphery of the wheel.

The conclusion from table tenth requires correction, but there is danger of error in departing from mean results. The following may serve to approximate toward the effect of varying the quantity upon the ratio of the velocity of the wheel to that of the impinging water. The mode of calculation is precisely the same as that for table tenth. The data are from table first.

TABLE TWELFTH.

Approximate corrections for the average results of table tenth.

Table A.	Head above gate.	Velocity of efflux. Aperture		Velocity of impact. Aperture		Velocity of wheel. Aperture		Mean ratio of veloc. wheel to veloc. impact. Aperture	
Number.	Feet.	0.50	1.25	0.50	1.25	0.50	1.25	0.50	1.25
5 & 14	2.75	7.91	7.52	10.34	10.10	5.28	5.58	.52	.55
18 & 31	2.25	7.18*	7.16	9.78	9.78	5.21	5.50	.53	.56
33 & 45	1.25	6.53	5.45	9 56	8.82	4.65	4.83	.48	.55
							Mean	.51	.55

* This number is for aperture .75, but no sensible error will result from its use here.

This table shews that with the lesser apertures the ratio of the velocity of the wheel to that of the water falls below the average ratio about four per cent., and with the larger rises as much above it. The ratio here is below that shown by table eleventh, viz., as 1.00 to 1.07, the apertures in this case being increased two and a half times, and in the former three times.

The second question under the general head 2, (p. 150) is in reference to the effect of the form of the gate through which water is delivered to the wheel upon the velocity of the wheel.

We have found, in discussing the effect of the different forms of gate used with this wheel, (see table eighth,) that, at a mean, the gate *b* dis charged more water through a given opening than *c* or *a*, and *c* more than *a*. The proportions were as 85, 72, and 63, or as 1.35, 1.14, and 1.00.

From the conclusion drawn from tables eleventh and twelfth, it appears that as the quantities of water under a given head are increased, the velocity of the wheel increases, though not in the proportion of the quantities. It ought, therefore, to follow that the form of the gate should influence the velocity; a question easily determined by recurring to the first, second, and third tables, and their summary in table fourth.

As the quantity of water delivered in a given time is an important element in the experimental data, it may be well to show here how closely the results from the mean of all the experiments made with a given head and form of gate, agree with the calculations from the experiments giving the ratio, and which are alluded to above. For this purpose it will be sufficient to give an abstract of the detailed tables, by which the discharges under different heads, and with gates *a*, *b*, and *c*, are compared with the theoretical discharges.

This is done in the following table; of which the first column contains the head; the second, the number of experiments from which the mean ratio is deduced; the third, the ratios of the observed discharge for gate *a*, to that calculated upon the head and aperture; the other columns contain data similar to those given in the second and third, but for gates *b* and *c*.

TABLE THIRTEENTH.

Mean ratio of practical and theoretical discharges through gates a, b, and c.

Head above gate.	Gate *a*.		Gate *b*.		Gate *c*.	
Feet.	Number of experiments used for mean.	Mean ratio, practical to theoretical discharge.	Number of experiments used for mean.	Mean ratio, practical to theoretical discharge.	Number of experiments used for mean.	Mean ratio, practical to theoretical discharge.
2.75	15	0.58	12	0.94	6	0.73
1.25	14	0.61	4	0.93	6	0.74
0.75			3	0.85	5	0.72
0.50	6	0.77	3	0.77	3	0.70
	Mean,	0.65	Mean,	0.87	Mean,	0.72

The striking accordance of these results with the former ones (viz: .63, .85, .72) is at once seen. In fact the detailed tables before referred to show a very satisfactory coincidence of ratio in the actual to the theoretical discharges, the circumstances being the same, thus proving that uniformity of aperture was insured, where it was attempted. We may confidently rely that a gate of the form *b*, will discharge thirty-four per cent. more water than *a*, and twenty per cent. more than *c*, under the same head and opening.

The velocities of the wheel obtained with these gates are in conformity with the conclusions already drawn. A comparison of the velocities under corresponding heads, from table fourth, shows for *a*, a velocity of 4.92 feet per second, for *c*, a velocity of 5.58 feet, and for *b*, a velocity of 5.84 feet, the proportion of the velocities being as 1.00 to 1.13 and 1.18.

It may be laid down, then, that *while the form of the gate does not influence the ratio of effect to power, it affects the velocity of the wheel.*

This variation may depend, in fact, upon the variation of quantity as already shown, but *must also depend upon the manner in which the water is delivered to the wheel by the gate*, as may be seen from the following table. In it a comparison is made between the variation in the velocity of the wheel produced by a variation of aperture, which of course changes the quantity, and the variation produced by the gates. As the head of water also changes the quantity but at the same time varies the velocity of the water, the results under different heads are presented separately in the first tabular view, and any effect from the heads is in a great degree eliminated in the second by the mode of taking the average.

TABLE FOURTEENTH.

Presenting the variation in the velocity of the wheel by a change of aperture, and by a change in the form of gate. Overshot No. I.

Effect of variation of aperture drawn from table twelfth.

Head.	Ratio under widths of aperture of 0.50	1.25
2.75	1.00	1.06
2.25	1.00	1.05
1.25	1.00	1.04

The same from table eleventh.

Width of aperture.	Ratio of vel. wheel.
0.50	1.00
0.75	1.01
1.00	1.12
1.25	1.08
1.50	1.12

Effect of change of gate in varying velocity.

Relative quantities discharged by the three gates.	Relative velocities of the wheel produced.
1.00	1.00
1.14	1.13
1.35	1.18

It is plain from this examination that while an opening will soon

be reached which will give the maximum velocity, and the change in this element becomes inconsiderable, the form of gate is of great importance in practice, in consequence of the mode in which the water is delivered by it to the wheel.

The third question to be examined under the general head 2, (page 150) is the proper velocity to be given to the periphery of an overshot wheel. It is one of the points of our subject which has been much discussed. Smeaton at first assigned three feet per second as the proper velocity for the periphery of the wheel, afterwards adopted eight and a half feet, and Oliver Evans deduced nine feet per second as the result of his experience. The experiments of the Committee show that within the limits where the diminished action of the weight of the water upon the wheel, by an increase in the head, begins to diminish the effect, there is a considerable latitude as to velocity.

In wheel No. I, as will be seen by recurring to table sixth, between the lowest head which would fill the aperture (.50 foot,) and the highest which the experiments admitted, and where the ratios began sensibly to diminish (2.75 feet,) there is a diminution in the ratio of effect, of but two per cent; and between .50 and 1.25 feet, the diminution is scarcely sensible. The range of velocities between these limits is shown by table tenth to be, for

Gate *a*,	4.44	4.88	5.43
Gate *c*,	4.60	6.15	5.35
Gate *b*,	4.65	5.22	7.59*
And at a mean	4.56	5.42	6.12

The velocity of the wheel having been before proved to be connected with the velocity of the water falling into the buckets, we now see that *without diminishing the ratio of effect to power more than two per cent. we may so arrange a high overshot wheel as to increase the velocity of its periphery from four and a half to six and an eighth, and probably even to seven and a half feet per second.* It is thus easily understood that the proper velocity in a given case could not be detected by experience, but required experiment for its determination.

3. *The quantity of work* done in a given time depends, when the ratio of effect to power is the same, upon the velocity of the wheel. The remarks, therefore, which have been made upon the latter subject will serve as guides to determinations concerning the former.

4. *On the relative value of elbow and centre buckets in an overshot wheel.*—As has been previously stated, experiments were made

* On examining the table whence this number is taken, there does not appear evidence to question its correctness.

with wheel No. I, furnished with both elbow and centre buckets. It has been heretofore shown, table ninth, that the elbow buckets were of a proper figure; we now propose to compare the results of the two kinds of buckets in reference to the ratio of effect to power, and also in reference to the velocity of the wheel.

The following table is taken from tables C and D (vol. viii, pp. 89 and 147,) the first containing the experiments with the elbow, and the second with the centre buckets, gate *c* being used in each case. The velocities are those corresponding to equal apertures.

TABLE FIFTEENTH.

Comparison of the ratios of effect to power with elbow and centre buckets. Overshot No. I.

Head.	Elbow buckets table C.	Centre buckets table D.	Elbow buckets table C.	Centre buckets table D.	Aperture.
Feet.	Ratio.	Ratio.	Velocity.	Velocity.	Inches.
2.75	.814	.628	5.35	6.86	1.00
1.25	.841	.640	6.20	5.66	1.25
0.75	.841	.666	5.07	5.66	1.50
0.50	.831	.655	4.60	4.65	1.50
Mean	.832	.647	5.31	5.71	
Ratio	1.00	0.78	1.00	1.08	

The ratio of effect to power with the centre buckets, is but .78 of that with the elbow buckets. No doubt owing to the water sooner leaving the former than the latter, notwithstanding the assistance of the breast.

The velocity of the wheel appears to be greater in the second case than in the first. This is in part due to the increased quantity of water received into these buckets, as shown in table ninth, but perhaps more to the irregularity observable by comparing the results in the second or third column of the last table with themselves. The first velocity in the column for elbow buckets, appears to be too small, and the third in that for the centre buckets to be too great.

5. *On the use of air vents.*—It is doubtful whether there can be need of air vents in a properly constructed elbow bucket. The openings made in the soling for this purpose have been described in a former part of this report. The results of experiments made with these vents open and closed are annexed.

TABLE SIXTEENTH.

Experiments with air vents open or closed. Overshot No. I.

Head.	Width of aperture.	Elbow buckets table C.	Centre buckets table D.	Air vents.	Relative effect for elbow buckets.	Relative effect for centre buckets.
Feet.	Inches.	Ratio.	Ratio.			
2.75	1.00	.814	.634	Closed.	1.00	1.00
"	"	.809	.582	Open.	0.99	0.92

It appears that the air vents being open or closed made scarcely a sensible difference in the elbow buckets, and produced a loss, from the escape of water, in the centre buckets.

6. *On the results of an overshot wheel allowance being made for the loss of power by the head of water above the wheel.*—The overshot wheel, in practice, losing something in its effect by the head of water above the wheel, it will be useful to ascertain the allowance to be made for different heads, and also whether having made a correction for this; the difference between the effect and power is not greater than may be due to the water in part leaving the bucket before it reaches the bottom of the wheel, and in part being carried beyond the centre by the motion of the wheel.

The first of these questions cannot be settled by reference merely to wheel No. I, the heads being small in proportion to the fall, but for the same reason the second problem may be examined advantageously, and its results applied to the experiments with the other overshot wheels.

In this view the effect of an overshot wheel as practically used, is to be considered as composed of the impulse of the water and of its weight, or of an undershot and overshot. The undershot co-efficient, or ratio of effect to power, has not yet been obtained but may be considered for the present purpose as .284. The head through which this acts is composed of two parts, the head above the gate, and the distance from the gate to the bottom of the bucket of the wheel. As the water receives through the latter an acceleration due to the whole distance, a virtual head* must be found for it before adding it to the former. The sum being multiplied by the overshot co-efficient gives a number proportional to the whole effect of impulse.

The distance from the bottom of the bucket to the bottom of the wheel multiplied by the true overshot co-efficient gives its proportion-

* This for the mean of gates *a*, *b*, and *c*, will be the distance from the aperture to the soling, divided by $(.73)^2$, or by .533; or multiplied by 1.876.

al effect. The sum should be equal to the observed ratio of effect to power, multiplied by the head and fall.

The following table is calculated upon this principle, the quantity sought being what may be called the theoretical overshot co-efficient.

TABLE SEVENTEENTH.

Ratio of effect to power in a theoretical overshot wheel.

Head and fall. Feet.	Overshot co-efficient from table 6th.	Head above gate. Feet.	Virtual head of impulse. Feet.	Undershot co-efficient used.	Product of head and fall by overshot co-efficient.	Product of virtual head of impulse by undershot co-efficient	Difference of two products.	Fall below bottom of bucket.	Quotient, or theor. overshot co-efficient.
23.00	.828	2.74	4.06	.284	19.04	1.153	17.88	19.4	.921
21.50	.842	1.25	2.56	"	18.10	0.727	17.37	"	.895
20.75	.845	0.50	1.81	"	17.74	0.514	17.23	"	.888
								Mean	.901

The effect thus appears at a mean to be nearly nine tenths of the gravity of the water. This result would be accounted for if the water leave the wheel at an average of two feet above the bottom.

If now we assume the average co-efficient .900 for the effect of the theoretical overshot we shall find the co-efficients for the different heads and falls as follows:

For	23.00	feet	.811
"	21.50	"	.848
"	21.00	"	.858

being in defect and excess of the actual ratios at the two extremes, between one and two per cent. The small variation of the head and fall, however, as has been before remarked, renders the coincidence of this result a test of comparatively little value.

[TO BE CONTINUED.]

On Indigo. Part II. *By* J. C. Booth.

CONTINUED FROM PAGE 164.

The chemical relations of Indigo-blue.—The blue substance contained in the indigo of commerce, being the only one of importance in colouring operations, its singular and unique action with many of the chemical agents, next demands our attention. According to the method of preparing the pure blue colour, described in the preceding part of the essay, it will be observed that a protosalt of iron was precipitated by lime, the protoxide becoming peroxide, while the blue colour of the indigo disappeared, as it united with the

lime. Here, then, according to the most commonly received theory, the indigo-blue has been deoxidized, and combines with the lime, after the nature of an acid. This important change first requires attention.

1. *Reduction of Indigo-blue.*—The deoxidation may be effected by any substances which have a strong affinity for oxygen, such as phosphorus, the sulphurets of potassium, calcium, antimony, and many sulpho-salts, particularly the sulf-arsenites, by protosalts of tin, iron and manganese, farther by filings of zinc, iron, tin, &c. Even organic materials, in the process of fermentation, have a similar action. The presence of a free alkali or alkaline earth is essential to the change, and seems to act by its presence or catalytic influence, as metallic zinc decomposes water by the presence of sulphuric acid, which unites with the newly formed oxide; for none of the above named substances will deoxidize indigo unless an alkaline base be present to combine with it when reduced. Thus in the process described in Part I, the reduced indigo combines with the lime forming a soluble compound, while the iron is peroxidized at the expense of the oxygen of the indigo-blue and precipitates. After the solution of the calcareous compound has become perfectly clear, it is drawn off by a syphon into another flask, so as to fill it even to overflowing, by which a small portion of the blue, which has reformed, may be carried off. A few drops of concentrated sulphuric or acetic acid previously deprived of air by boiling or in vacuo, are now added, and the flask closed by a well ground stopper, whereupon an abundant white and flocculent precipitate appears which slowly collects at the bottom of the vessel. This is reduced or deoxidized indigo. The clear liquor is drawn off, and the precipitate, placed on a filter, is washed with well boiled water, (during which operation it gradually becomes grayish green,) then dried between paper and in vacuo, or even in the air at a very moderate temperature, 75° Fahrenheit. The greenish shade it assumes appears to be an intermediate state of oxidation between the white and blue. Reduced indigo is white, somewhat crystalline; has neither taste nor smell, does not redden litmus paper, and is insoluble in water. It dissolves in alcohol and ether, with a yellowish colour, from which it separates as indigo-blue, either by exposure to air or boiling down. In a moistened state, it becomes deep purple in a few hours, in dry air, it changes to blue, only after several days. So strong is its attraction for oxygen, that it cannot be kept even in closely stoppered bottles. By heating the dry mass cautiously in the open air, when the temperature rises to a certain point, it suddenly becomes dark and purple coloured; a phenomenon resembling the sudden oxidation of a metal. By a higher heat it rises as a pur-

ple gas. It appears to have no affinity towards dilute acids, but dissolves instantly in concentrated sulphuric acid, with a deep purple colour. The nature of this solution is unknown; but may it not arise from a reduction of a portion of sulphuric to hyposulphuric acid, which combines with the newly formed indigo-blue? It combines forcibly with strong bases, being dissolved by carbonated and caustic alkalies, and by caustic baryta, strontia and lime, with a yellow colour.

The combinations of reduced indigo with the bases cannot be obtained pure in a dry state, for even under the air-pump they change so far as to conceal their characters. Lime forms two combinations; the one exactly saturated with the indigo is soluble in water, the other with an excess of lime, insoluble, and of a citron yellow colour. Magnesia likewise forms a compound somewhat less soluble. Other compounds may be obtained by introducing a crystalized salt into a saturated solution of reduced indigo. Salts of alumina, protoxides of iron and tin, and oxide of lead, precipitate white compounds, which become instantly blue in the air; oxide of cobalt and protoxide of manganese, form green, and oxide of silver, brown and black precipitates.

It appears, then, that reduced indigo, although presenting no acid character in itself, combines with bases after the manner of an acid, forming both soluble and insoluble compounds; that its attraction for oxygen is powerful, becoming converted thereby into indigo-blue, which is an unusually indifferent substance.

When indigo is obtained from plants, it does not exist in the juice of the plant as such, but is formed after its expression, and by contact of the air. It is therefore highly probable that it is contained in it as reduced indigo, but as the latter is insoluble in acids, and requires the presence of a base, while the infusion of indigo plants always reddens litmus, it remains to be determined, by future experiments and observations, in what state it exists in the juice of the plants.

2. *Soluble Indigo-blue.*—Sulphuric acid has a peculiar decomposing action on various organic substances, combining with a portion of the generated products, and although retaining its acid character, ceases to exhibit the properties of sulphuric acid; for the body combined with the acid cannot be separated from it by bases, but enters into the composition of its salts, which are very different from sulphates. Indigo-blue is one of these substances, and exhibits properties, the theoretic nature of which remains a mystery.

When Indigo-blue, purified from the brown, red, &c., as described in Part I, is treated with fuming sulphuric acid, it combines with it rapidly, evolving heat, and no sulphurous acid; even dry sulphuric

acid produces the same result. Dilute acid has no action, and the stronger the acid, the more colouring material is dissolved. Thus while six parts of the fuming acid are requisite for the solution, twelve parts of strong oil of vitriol are required, and then usually with the assistance of a temperature not higher than 212° Fahrenheit. Such a solution communicates a distinct blue colour to 500,000 times as much water. As the exact nature of the combinations is not understood, we shall follow the ordinary nomenclature, and call the two acid compounds resulting from the solution, ceruleo-sulphuric and ceruleo-hyposulphuric acids; a third compound also results, called indigo-purple, or phenicine, but as it is unimportant, the mention of it may be sufficient. The more fuming the acid, the more blue hyposulphuric is formed, and the less residue of indigo-purple, while strong oil of vitriol produces more of the blue sulphuric, and frequently leaves a large portion of purple.

These acids may be prepared by digesting the pure indigo-blue in a dry state, in twelve parts of very concentrated sulphuric acid, adding the powdered colour little by little to the acid, and suffering the mixture to stand twenty-four or forty-eight hours, according to the temperature, which should not be above 212°; it is then diluted with thirty to fifty times its bulk of water, and filtered. What remains on the filter is indigo-purple. Wool or flannel, thoroughly cleansed by soap, a very dilute solution of carbonate of soda (1 to 100) and water, is immersed and digested in the liquid at a moderate warmth, by which the blue acids are extracted, and colour the wool of a deep blue. When all the colour is thus taken up, the wool is thoroughly washed with water, pressed, and put into a very dilute solution of carbonate of ammonia, whereupon the acids leave the wool and combine with the ammonia. This solution is evaporated to dryness at 140°, and treated with alcohol of 0.833, which dissolves the ceruleo-hyposulphate of ammonia, and leaves the blue sulphate undissolved.

Ceruleo-sulphuric acid is obtained by dissolving the last named salt in water, and precipitating with acetate of lead, which throws down ceruleo-sulphate of lead. By stirring this salt with water, and passing sulphuretted hydrogen through it, sulphuret of lead is precipitated while the reduced blue remains in the yellowish liquid. It is deoxidized blue in combination with sulphuric acid, which, by exposure to the air, becomes the ceruleo-sulphuric acid. The blue hyposulphuric acid is obtained by precipitating the above alcoholic solution of the ammoniacal salt by a solution of acetate of lead in alcohol, and then proceeding as for the sulphuric acid. In either, the sulphuretted hydrogen should be removed, and the liquid should not be filtered until it is perfectly blue.

The blue acids have a powerful affinity for bases, and the resulting compounds, are not to be regarded as double salts, for in the ceruleo-sulphate of baryta, the sulphuric acid exactly saturates the baryta, so that the blue colour appears to combine with the salt, somewhat like water of crystalization in ordinary salts. It will appear from this that it still remains for the chemist to determine in what manner the blue colour combines with the acids. These ceruleo-salts have all a fine blue colour, whether soluble or otherwise, taste slightly saline, and very strongly like indigo, and require a considerable amount of heat to decompose their organic colour. The sulphates of the alkalies are scarcely soluble in alcohol of 0.84, and are precipitable by colourless alkaline sulphates, and even by other salts. The corresponding hyposulphates are soluble in alcohol, and scarcely precipitated by other salts. Both series of salts, when soluble in water, leave by evaporation to dryness, an uncrystalized mass, with a cupreous metallic lustre, surpassing that of insoluble indigo-blue. The ceruleo-salts of potassa, soda and ammonia, may be prepared pure by digesting the blue wool, alluded to above, in the carbonates of those alkalies to saturation, evaporating to dryness, and treating with alcohol, which dissolves the blue hyposulphates, and leaves the ceruleo-sulphates. The corresponding compounds of lime and magnesia are prepared, as those of the alkalies may also be, by treating the solution of indigo-blue in sulphuric acid by their carbonates, and by farther separating the two series from each other by alcohol. The salts of baryta and lead may be precipitated from the soluble alkaline compounds, by solutions of those metals.

The blue colour in the two acids is susceptible of a deoxidation similar to insoluble indigo-blue. If filings of zinc or iron be placed in their solution, the metals are oxidized at the expense of the blue colour, for hydrogen is not evolved, and with an excess of acid the solution is colourless or yellowish, but instantly becomes blue by contact with oxygen or atmospheric air. It is the most delicate of all tests for the presence of oxygen gas. The blue colour is more easily reduced in the salts than in the acids, and most readily when there is an excess of base. A beautiful experiment illustrates this property. Protosulphate of iron may be dissolved in a neutral blue solution, and heated in it without inducing reduction; even a large portion of protoxide of iron may be precipitated with alkali without producing a change; but the moment we add an excess of alkali, the blue fluid instantly changes to yellow. By saturating the solution with acid, it soon becomes blue, and may again be rendered yellow by a new excess of alkali. It is remarkable that indigo-blue should suffer its

peculiar deoxidation, but more so that this soluble blue should resemble it in this feature, although differing in most others.

The blue colour is not so firmly united to the two acids of sulphur as not to form other compounds; thus by mingling chloride of calcium with a blue solution, and adding phosphate of soda, a fine blue phosphate of lime precipitates; if carbonated alkali be added, a less brilliant ceruleo-carbonate of lime is thrown down. Even tannate of oxide of lead may be obtained as a blue precipitate, by throwing acetate of lead and tannin simultaneously into the solution. It would be highly desirable to multiply experiments of such a character, as the transposition of the blue colour may yet prove of service in dyeing and printing operations.

Soluble indigo-blue is as fugitive as many vegetable sap colours, suffering alteration from the solar ray, heat, nitric acid, caustic alkalies, &c., forming new bodies which unite with the sulphuric and hyposulphuric acids, and give rise to new acids. If ceruleo-hyposulphate of baryta be evaporated to dryness in a water bath, it becomes green, and contains *virido-sulphuric acid*, which may be obtained like the blue sulphuric. If one part of ceruleo-sulphate of potassa be dissolved in fifty parts of lime-water, and heated in a closed vessel, for several hours, the solution becomes of a purplish red colour; by filtering, and passing carbonic acid through the solution, evaporating to dryness, and treating with alcohol, a small portion is dissolved with a red colour. The insoluble residue dissolves in water with a dark purple-red hue, and being precipitated by neutral acetate of lead, gives a salt containing a new acid, the *purpuro-sulphuric.* If the blue sulphate of potassa be similarly treated, in an open vessel, with lime water, the colour of the solution graduates through green, purple, and red, into yellow; but by ceasing when it is red, precipitating by carbonic acid, and evaporating to dryness, alcohol extracts a yellow compound, while the residue becomes red. Sugar of lead throws down from the tincture a citron yellow salt, containing *flavo-sulphuric acid*, while the remaining fluid is red. The red residue insoluble in alcohol, and the last red solution contains a reddish acid, which, by solution in absolute alcohol, yields *fulvo-sulphuric acid* of a reddish-yellow tint; and the residue insoluble in absolute alcohol, gives a fine red solution with water, containing the *rufo-sulphuric acid.* A cursory view of this subject might lead to the supposition that these singular, varied, and beautiful compounds, although interesting to the chemist, can never be rendered available in practical operations; but we have already too many instances in the arts of substances now employing the hands of numerous artisans, which only sprang into existence under the touch of the chemist, to listen

to such assertions. When the existence of chrome was first made known to the world, who could have imagined that it was destined to play an important part in the arts; or even when sand and alkali first fused together, by an accidental intensity of heat, who could have known that the resulting glass would eventually prove a source of many of the comforts and conveniences of mankind? Neither can we now assert that an intimate knowledge of the varied and curious properties of indigo arising from the labours of the chemist, can prove of no benefit to manufactures.

3. *Action of nitric acid on Indigo.*—This acid has a peculiar decomposing action on a variety of organic substances, giving rise to a host of new products, which are not yet well understood. Thus by its action on indigo, it produces several distinct acids, of which but little is known, not so much from a want of extended observation and experiment, as from the extreme difficulty attending such chemical investigations. If we employ nitric acid, of 1.28 sp. gr., diluted with an equal bulk of water, and add to it one part of finely powdered indigo, as fast as it is decomposed, with the assistance of warmth, two acids form in the solution, and by concentration, precipitate together in a crystalline form. By solution in boiling water, and cooling, fine needles separate, which are *nitroanilic acid,* formerly called indigotic acid. It may be purified and separated from the *nitropicric acid,* which is also formed, by boiling its solution with freshly precipitated carbonate of lead, when the nitroanilate of lead remains in solution. When purified, the acid crystalizes in fine white needles, of a strong acid taste. It combines with the alkalies, earths, and many metallic oxides, forming yellowish or reddish compounds.

The nitropicric acid may be formed more readily by digesting one part of indigo with 8 to 10 parts of moderately strong nitric acid, with the assistance of a gentle heat, and as soon as the liquid ceases to evince decomposition, and is still, by heating it to boiling, and adding, from time to time, nitric acid, as long as nitric oxide is evolved. The fluid, suffered to cool, deposites crystals of the acid, frequently called the carbazotic, and formerly Welter's Bitter. It combines with bases, usually forming yellow salts. The salt, with potassa, being rather insoluble in water, and wholly so in alcohol, this acid has been employed to detect the presence of potassa. It has also been recommended by Braconnot as a remedy for intermittent fevers. Excepting these, the salts of these two acids have received no practical application. In regard to the manner in which their elements are combined, it is difficult to hazard a conjecture; but Berzelius rather regards them as organic bases combined with nitric acid. Thus the nitroanilic acid may be represented as $(C^{14}H^{8}O^{4})+NO^{5}$; and the

nitropicric as composed of $(C^{12} H^4 N^2 O^3) NO^5 + (HO) NO^5$; and when the latter combines with a base, as potassa, the HO, or atom of water, is replaced by that base; thus $(C^{12} H^4 N^2 O^3) NO^5 + (KO) NO^5$. It is probable that much time will not elapse ere these dark regions in organic chemistry will be illuminated by advancing science. They have been presented, as well to give a complete and yet condensed view of the subject of this essay, as to point out the numberless modifications of which a single substance is susceptible. In the succeeding part of the essay, we shall devote a few pages to the practical operations connected with indigo.

[TO BE CONTINUED.]

Report to the Trustees of the Philadelphia Gas Works, on the progress and state of the Works, January 22, 1841. *By* J. C. CRESSON, *Superintendent.*

In compliance with the request of the Board, the Superintendent has the honour to present a brief history of the works from their commencement, and a view of their present operations and capacity.

Ground was broken on the site selected for the location of the works, in the month of April, 1835, about one month after the final passage of the ordinance of Councils authorizing their construction.

The erection of the buildings and apparatus, and the laying down of the main pipes in the streets, were prosecuted with the characteristic energy of the engineer, Samuel V. Merrick, Esq., and they were so far completed as to be in readiness for the manufacture and reception of gas on the 8th of February, 1836, less than ten months from their commencement; and on the 10th of February, the gasometer and mains were filled, and gas furnished for public and private lighting. The works then completed, consisted of a retort-house, 98 by 48 feet, capable of accommodating thirty retorts, and storage for 12,000 bushels of coals; a purifying and lime house, 40 by 20 feet, containing one set of dry lime purifiers; a set of vertical condensing pipes, placed on the north side of the purifying house, above ground, presenting a surface for deposite of 600 square feet; a range of buildings, 133 by 20 feet, containing office, meter room, laboratory, and workshop; and two gasometers, fifty feet in diameter, with a capacity of 35,000 cubic feet each, in tanks of masonry, entirely under ground.

The street mains laid, comprised 9140 feet of ten inch pipe, partly in Filbert, and partly in High streets, extending from the works to Delaware Second street; pipes of two, three, and six inches diameter, in some of the lateral streets, chiefly Second, Third, and Fifth streets, and four and six inch pipes in Chesnut and High streets, to the extent of 4018 feet of six inch, 9430 feet of four inch, 12,400 feet of three inch, 2310 feet of two inch, and 1354 feet of branches, making a total

of 38,652 feet, or seven and one third miles. On this extensive line of mains, only nineteen private and forty-six public lights were ready to receive gas when the works were first in a condition to furnish it. This paucity of consumers resulted, not from any indifference on the part of the public, but from the tardiness with which the few persons engaged in the business of putting up gas fittings completed their work. The usual laws of supply and demand soon called into the business many of our enterprizing mechanics, who, by their activity, were able to keep pace with the increasing calls for the means of lighting with gas; and by the close of the year it was supplied to 2800 private, and 165 public lights, consuming daily about 42,000 cubic feet. The maximum daily consumption in the first year, was 48,500 cubic feet, and the whole quantity made in $10\frac{1}{2}$ months, 6,481,300 cubic feet. The progress of the demand is shown in the second column of the accompanying table, marked A.

In the course of this year, a small addition was made to the street mains of 2951 feet of three inch pipes.

At the close of 1836, authority was granted by Councils to extend the works, by means of a loan of $ 150,000; on condition, that before any dividend to the Stockholders should be declared, the sum of eight per centum on the amount borrowed for the extension of the works, should be annually set apart and reserved from the nett profits, to be applied, first to the payment of the interest on said loan, and the balance to be invested as a sinking fund for its redemption, in case the Stockholders should be allowed to retain possession of the works until the loan reached maturity; which was to be in twenty-five years. The said sinking fund, and its accumulations, to revert to the Stockholders, if Councils should take possession of the works prior to the twenty-five years, which they have the power to do at any time they may see fit. Measures were promptly taken by the Trustees to give to the public the benefit of this addition to the means at their disposal. The works were originally laid out on a plan which would admit of symmetrical enlargement, without interference with the parts already constructed; by the erection of additional sections, corresponding in exterior to the first, but entirely independent and complete in the interior arrangement and apparatus.

The first step in this system of enlargement was undertaken in the year 1837.

The retort-house was extended to nearly double its original length, and by the adoption of a different arrangement of the interior, was made capable of receiving sixty additional retorts, and furnishing store room for 25,000 bushels of coal. The bench for thirty retorts was completed at once, and the second section, thus formed, was pro-

vided with purifying and condensing apparatus, by converting the lime house into a purifying house, and fitting up therein a second set of purifiers, with a series of condensing pipes and drips against its northern flank. A range of sheds, supported on cast-iron columns, was erected against the walls which enclosed the yard, which furnished store room for 100,000 bushels of coal and coke.

Two additional gasometers, with their tanks, similar in their dimensions to those in use, were constructed; and the part of the lot thus filled up, was enclosed with a substantial brick wall.

In a word, the productive capacity of the works was doubled, and accommodations provided in part, for another section, whenever it should become necessary, and a storage of an ample supply of coals provided under cover. As the consumption of lime for purification had increased sufficiently to make it an object to produce it on the premises, a small perpetual kiln, for calcining shells, was put up, and the whole supply of lime economically obtained, by burning oyster shells with the refuse breeze from the coke. The extension of main pipes in the streets was made to keep pace with the enlargement of the works; the additions were as follows: ten inch, eighteen feet; six inch, 6984 feet; four inch, 4302 feet; three inch, 13,068 feet; two inch, 3468 feet; in all, 27,840 feet, or five and one quarter miles, making an aggregate of thirteen miles of street mains. The number of lights supplied at the close of the year, had increased to 6814 private, and 300 public lamps. The maximum daily consumption in the year was 105,500 cubic feet, and the whole quantity of gas produced in the year, 17,078,000 cubic feet, making a total production of 23,560,000 cubic feet.

Two dividends, of four per cent. each, were paid to the Stockholders this year, one of the profits earned to the first of January, in the first ten months operations, and the other, of those earned in the six months, ending the first of July.

The rapid increase in the demand for gas having more than doubled the daily consumption, and the growth being as yet unabated, with every prospect of its longer continuance, it became necessary to look to some provision of additional leading mains for the supply of the remote eastern sections of the city, and an extension of gas store room at the works. To meet these contingencies, a second application was made to Councils for authority to raise the requisite funds, by loan, and this was granted, to the amount of $200,000, upon the same conditions as were imposed on the first loan. In accordance with the system marked out, when the plan of the works was originally adopted, a sixteen inch main was carried south from the works, along Ashton street to Spruce, a distance of 2340 feet; and from this a

twelve inch main was laid down Spruce street, from Ashton street to the Delaware, 10,881 feet. The Spruce street main was laid as far as Ninth street, a distance of 8000 feet, without any branches for lateral connexions; being designed to insure a full supply to the eastern parts of the city.

From the twelve inch main, six inch pipes were branched at Ninth, Sixth, and Second streets, to connect and complete the circulation between the two great mains on the northern and southern routes; the connexions at Sixth and Second streets were completed, and the six inch mains extended to the northern boundary of the city, at Vine street. Numerous smaller mains of two, three, and four inches diameter, were laid in different parts of the town, to accommodate the applications for gas, which continued throughout the year with scarcely any abatement in number and frequency.

The extent of mains, of various sizes, laid in 1838, was sixteen inch, 2340 feet; twelve inch, 10,881 feet; ten inch, 27 feet; six inch, 9036 feet; four inch, 14,409 feet; three inch, 15,660 feet; two inch, 150 feet; total, 52,503 feet, or nearly ten miles, which, added to those previously laid, made the whole extent of street mains twenty-three miles.

The increase in the consumption of gas continued during this year in the same remarkable ratio as in the preceding, the number of customers, and the amount of gas sold being more than doubled. The maximum daily consumption was 180,000 cubic feet, and the whole quantity made in the year, 27,357,000 cubic feet; the number of private lights, at its close, was 11,102; of public lamps, 434. Two dividends, of six per cent. each, were paid to the Stockholders, out of the profits earned, to the first of January and July of this year, and the semi-annual dividends since then have been of the same amount. The unparalleled augmentation of the demand for gas, which had hitherto been experienced, had made it necessary to continue an almost uninterrupted series of extensions of the capacities of the works, and pipes of conduit; on one occasion it was deemed most prudent to close the book for applications, lest they should increase too rapidly for the means of supply. But the establishment had now attained a magnitude which rendered it probable that the same rate of increase could not be maintained for a much longer time; and yet the additions to the number of consumers were on the increase during the greater part of the year just closed, and thus far showed no symptoms of abatement. Under these circumstances, it became a matter of no little difficulty to determine the proper rate for future extensions, so as, on the one hand, to keep pace with the wants of the public, and on the other, to avoid the unnecessary loss of interest from premature

expenditure of funds. The buildings and apparatus for the manufacture of gas, are of such a character as to require considerable preparation, and months of labour for their proper construction; and the measures to be adopted must therefore be predicated, not upon the present condition of the business, but upon its prospective condition some ten or twelve months in advance.

Upon deliberate consideration of the whole ground, it was thought most prudent to make another addition to the works in 1839, although at the close of the preceding year they were capable of furnishing some 40,000 or 50,000 feet more per day than the average demand.

Accordingly, the bench for thirty retorts, in the third section of the retort-house, was fitted up, and an addition was built to the purifying house, and furnished with the requisite purifiers, condensers, &c., to complete a third series of works, equal in capacity to each of the other two. Four additional tanks were likewise constructed, with gasometers corresponding to the four already in use; and a store cellar built alongside of the retort-house, with room for 60,000 bushels of coals. The quantity of gas produced by each section of the retort-house having been increased considerably beyond what they were originally estimated to be capable of generating; it was found that the purifying apparatus, as first arranged, was insufficient to render the gas as pure as it ought to be, and it became necessary to devise some means of adding to its efficiency, without throwing out of use the extensive fixtures which had already been constructed. This was effected by adding a second story to the purifying house, and placing on the upper floor duplicate sets of purifiers, connected collaterally with those below; which gave a double extent of purifying surface, and passed the gas at a reduced pressure, sufficiently purified, without any departure from the ground plan already adopted.

For the more perfect separation of ammoniacal deposits, which sometimes prove a source of much annoyance to the gas manufacturer, a set of large refrigerating cylinders was put up between the retort-house and condensers; these are supplied with jets of water, throwing into each cylinder about two gallons an hour; and since they have been in operation, in conjunction with the double sets of purifiers, the gas passes from the works free from any appreciable noxious impurity, even when subjected to the nicest tests of the laboratory. The means of distribution likewise received considerable additions this year; the mains laid, were eight inch, 3726 feet; six inch, 4419 feet; four inch, 11,997 feet; three inch, 11,629 feet; and two inch, 1704 feet; in all, 33,475 feet, or about six and one quarter miles, making an aggregate of $29\frac{2}{5}$ miles. The maximum consump-

tion was 207,000 cubic feet, and the whole quantity of gas made, was 39,473,000 cubic feet.

The number of lights supplied at the close of the year, 15,851 private, and 596 public.

A comparison of the operations of the works for the year 1839, with those of the previous year, shows that the ratio of increase of demand had very much fallen off, being less than fifty instead of one hundred per cent., as in former years; this may be taken as an indication that the boundaries of the profitable districts had been passed, and that future extensions would tend rather to diminish than to increase the profits of the concern. This impression has been confirmed by the experience of the next succeeding year, which has just elapsed; the increase of demand for gas being again, not only in a very much diminished ratio, but the actual excess only about one half that of the preceding year.

During the year 1840, the improvement at the works have been limited to the completion of the improved plan of the retort-house, by taking down the retort-bench of the old section, and remodeling it so as to make room for a double bench, with coal stores below, as in the section last built; a change which it was necessary to make, while the summer demand was within the capacity of one double bench with sixty retorts. The pipes laid have been only a few small sections to complete connexions, or supply applicants near the terminations of the lines.

They comprise, six inch, 261 feet; four inch, 576 feet; three inch, 1674 feet; and two inch 222 feet; in all 2733 feet; making the total length of mains 158,136 feet, or nearly thirty miles.

The maximum daily consumption of gas was 249,000 cubic feet, and whole quantity made in the year, 45,210,000 cubic feet, the number of lights increased to 19,799 private and 708 public.

These details have brought our history down to the present period; and it remains to give a connected view of the result of the transactions narrated, by a general sketch of the existing condition and capacity of the establishment.

The retort-house is a brick building, 195 feet long, 48 feet wide, and 18 feet high; covered with a roof composed entirely of iron; with an arched brick floor, resting on cast iron girders. The retort-benches are in two double ranges, placed back to back, with one horizontal flue, common to each double range; the two flues terminating in a single stack, 100 feet high, standing in the centre of the building. The whole will contain 120 retorts. The retorts are D shaped, seven feet long, two feet wide, and one foot high; and work off four hour charges of 150 pounds of coal; producing about 4,000 feet of gas in

twenty-four hours; they are set three to a fire. The standing pipes and dip-pipes are four inches diameter; the hydraulic main fourteen inches; and the general connecting pipes six inches. The gas is washed as soon as it leaves the hydraulic main; and passes from the washers to the refrigerators, which are upright cylinders, on square bases, eighteen feet high and forty inches diameter; four of these constitute a set, and are connected, so that two are collateral, and two consecutive; the connexion being through a double valve, by which one pair may be thrown out for cleaning or repair, without stopping the works.

From the refrigerators, the gas passes to the condensers, composed of a series of twenty upright pipes, eighteen feet high, and six inches diameter; standing upon drip boxes, which are drained by a connected series of syphons. The refrigerators stand on the south side of the purifying house, exposed to the weather; and the condensers on the north side, enclosed by a verandah with revolving venitian blinds, which are kept closed when the weather is severely cold. The purifiers are rectangular cast iron boxes, four feet square, and two and a half feet deep, with sheet iron caps, secured by a water lute. Three layers of lime, about three inches thick each, are placed on wicker bottoms, in each box;—eight of these boxes form one set; four being on the lower, and four on the upper floor of the building: the two boxes in the same vertical line are connected collaterally, and the gas passes through three double boxes in succession; the fourth being thrown out for the renewal of the lime: a single hydraulic valve forms the connexion for the eight boxes of one set.

Three sets of purifiers are completed, and the building is fitted for the reception of a fourth; its dimensions are eighty-five feet in length, twenty feet in width, and twenty-two feet in height, with a cellar under the whole, in which are placed the drips and syphons for the purifiers and refrigerator valves.

The range of buildings, comprising offices, workshops, and meter room, has received no exterior addition since its first erection; being as before stated, 133 feet long and 20 feet wide, constituting the front of the works on Ashton street; but two new station meters, of sufficient size to pass 10,000 feet per hour, have been placed in the meter room, and connected with the new sections of the works, so that the gas generated in each section, is separately measured; provision is made, however, for connecting either of the meters with all the sections, if necessary; and a similar precaution has been adopted in other parts of the works, so that if the condensers, purifiers, or meter of either section should need to be thrown out for inspection or repair; the gas generated in that retort-house can be passed through the apparatus of the others. The gasometers are now eight in number, with an aggre-

gate capacity of 280,000 cubic feet, and are so connected, as to work through either a single outlet of ten inches diameter, or through two independent outlets of the same size. The suspension is by three points; the chains converging to a single point, and connected to the counterweight by a cross bar.

The pulleys are supported on a triangular trussed bridging, sustained on cast iron stands eighteen feet high.

The works now completed occupy one half of the plot appropriated to their use, and are so arranged as to unite symmetrically with a similar series, to be constructed when needed, on the other half. The entire dimensions of the site are 306 feet, north and south, by 738 feet, east and west; intersected by Ashton and Beech streets, each fifty feet in width; it is bounded on three sides by public streets, and on the fourth by the Schuylkill river. One of the intersecting streets separates the gasometer yard from the offices and factory, and the other passes between the factory and the wharf front on the river. The space between Beech street and the river, is now used for the deposit of foul lime, and of shells from which the lime is made; the lime-kiln being on a portion of it: at a future day it will furnish valuable store-room for coals.

The present capacity of the works is sufficient to supply 300,000 to 350,000 cubic feet daily, with storage for 280,000 feet of gas, and 200,000 bushels of coals.

When the fourth section is completed, all the buildings for which are now provided, the productive capacity will be about 450,000 cubic feet per day.

The system of street mains consists of a sixteen inch main in Ashton street, from the works to Spruce, a distance of 2,340 feet; which is to head all the east and west mains; a twelve inch, down Spruce from Ashton street to the Delaware, 10,881 feet; a ten inch, from Ashton, down Filbert to Ninth, and along Ninth to High, and down High to Delaware Second street, 9,167 feet; these two mains being intended for the supply of the eastern part of the city, have no lateral connexions, except for services, until they reach Ninth street. There is also a main along High street from Ashton to Delaware Front street, consisting of eight, six and four inch pipes, about 10,000 feet in length; a six inch main in Chesnut, from Ashton to Ninth, and thence continued to Second, four inch, 9,500 feet; a four inch in Mulberry, from Delaware Front, to 150 feet west of Broad street, 6,000 feet; a four inch in Sassafras, from Delaware Second to Broad, about 5,300 feet; a four inch in Walnut street, from Dock to Schuylkill Seventh, about 6,000 feet; a four and an eight inch in Ceder street, from Delaware Second to Fourth, about 1,000 feet each.

Besides these leading east and west mains, several small sections have been laid in different streets to supply applications for light.

The lateral connexions embrace a three inch in Front, from Mulberry to High; a six inch on the east, and a three inch on the west side of Delaware Second, extending the whole breadth of the city from Vine to Cedar, each 5,370 feet in length; three inch on both sides of Third, from Vine to Spruce, except two small breaks, one on the west side, near Sassafras, and the other on the east side at Dock street; a three inch in Fouth street from Vine to Spruce, partly on both sides; a three inch in Fifth steet, from Sassafras to Spruce, partly on both sides, but with several breaks of continuity on both; a six inch in Sixth street, from Vine to near Pine, and connected at Pine by about 200 feet of three inch. Several squares of three inch in Sixth street, in small sections; a three inch in Seventh street, from Mulberry to Walnut; three inch in Eighth, from Cherry to south of Walnut, and from Locust to Spruce; a six inch in Ninth street from Sassafras to Locust, on the west side, and about 500 feet of three inch on the east side; several sections of three inch in Tenth, Eleventh, and Twelfth streets; a three inch in Thirteenth street, from St. John's Church, near High street, to St. Luke's below Spruce; a six inch in Broad street from Walnut to Pine, and about 200 feet of six inch south of Chesnut, both on west side; and sundry connexions of two and three inch pipes in the smaller streets and alleys. Comprising in the whole extent, of sixteen inch 2,340 feet, twelve inch 10,881 feet, ten inch 9,167 feet, eight inch 3,726 feet, six inch 24,718 feet, four inch 41,468 feet, three inch 57,982 feet, and two inch 7,854 feet—total, 158,136 feet, or within 264 feet of thirty miles.

The number of lights on these lines of mains, at the close of 1840, was, private 19,799; public, in streets 708, market houses 19, public squares, lighted only in summer, 62: making an aggregate of 20,588 lights in operation.

The whole cost of the establishment has been as follows:—

For Works on Schuylkill, - -	$237,903 28
For Street Mains, - - - -	168,957 22
For Services, - - - - -	56,135 95
For Public Lamps, - - - -	9,640 75
Total permanent investment,	$472,637 20

There is the sum of about $6000 outstanding, on account of permanent improvements, but as the stock of materials on hand is sufficient to liquidate the whole of this, it will not produce any material change in the amount above stated as the cost of the present series of Works, and means of distribution.

Annexed, are tabular statements giving a condensed view of the progressive condition of the several principal departments for each year since the commencement of operations. In statement A, is shown the length and size of main pipes laid in the streets; in B, the number of service pipes and meters set for customers; in C, the number of public and private lights in operation; in D, the quantity of gas made in each month; and in E, the sales of gas as registered by small meters. Each private customer is furnished with a meter, placed in his premises at the expense of the Company, and his bill made out from its indications. Similar meters are placed at several of the street lamps, in different parts of the city, and their average taken as the average of the whole number of lamps.

A comparison of D and E, shows the amount of loss from leakage and waste. The large proportionate loss in the first year was caused by the filling and proof of the gasometers, and blowing out the air from the street mains, when first brought into use: and that which has since occurred, is principally due to the opening of the mains for connexions, or attachments of service pipes. When these operations have been temporarily suspended, the loss has fallen below two per cent.; a fact which proves the almost perfect tightness of the extensive line of mains with its numerous joints.

[A.]—*Length of pipe, in feet, laid each year.*

Years.	2 inch.	3 inch.	4 inch.	6 inch.	8 inch.	10 inch	12 inch.	16 inch	Total.
1835	2310	13,000	10,184	4,018		9140			38,652
1836		2,951							2,951
1837	3468	13,068	4,302	6,984					27,822
1838	150	15,660	14,409	9,036		27	10,881	2340	52·503
1839	1704	11,629	11,997	4,419	3726				33,475
1840	222	1,674	576	261					2,733
	7854	57,982	41,468	24,718	3726	9169	10,881	2340	158,136

[B.]—*Number and size of Meters set each year.*

Years.	3 light	5 light.	10 light.	20 light	30 light	45 light	60 light	100 light	Total.
1836	108	98	31	9	2	3			251
1837	301	77	19	6	2	3		3	411
1838	442	159	61	13	9	2	1	3	690
1839	421	118	75	26	6	3			649
1840	198	78	54	13	3	2		2	350
	1470	530	240	67	22	13	1	8	2351

[C.]—*Number of Lights added monthly.*

	1836.		1837.		1838.		1839.		1840.	
Months.	Public.	Private	Public.	Private	Public.	Private	Public.	Private	Public.	Private
January.				143		120	*18	511	*1	340
February,	46	529		235		185		559		338
March,		266		246		261		317		141
April,	34	515		253		207		446	6	221
May.	20	156		93	1	118		538	1	316
June,	22	139		55		192		400	7	112
July,	20	135		115		299	58	341	7	135
August,	20	193		760		378	33	389	4	193
Sept.,	3	241	36	402		333	14	533		704
October,		373	33	510	80	584	36	606	52	491
Nov.,		145	30	666	18	500		446	34	528
Dec.,		240	37	297	34	587	21	294	1	429
	165	2932	136	3775	133	3,764	180	5,380	113	3,948
			165	2932	301	6,707	434	10,471	614	15,851
			301	6707	434	10,471	614	15,851	†727	19,799

* In Market Houses.

† To these may be added sixty-two Lamps, placed in Franklin and Washington Squares in 1838.

[D.]—*Gas made at Works.*

	1836.	1837.	1838.	1839.	1840.
	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
January,		1,156,400	2,430,000	4,057,000	4,796,000
February,	205,200	1,006,200	1,980,000	3,437,000	4,082,000
March,	359,000	1,306,100	2,064,000	3,638,000	3,915,000
April,	362,300	1,104,400	1,918,000	2,862,000	3,362,000
May,	453,200	960,400	1,583,000	2,555,000	2,974,000
June,	361,600	866,400	1,471,000	2,058,000	2,454,000
July,	353,200	903,100	1,527,000	2,068,000	2,388,000
August,	442,300	1,078,100	1,669,000	2,301,000	2,506,000
September,	658,700	1,517,800	2,095,000	3,041,000	3,487,000
October,	921,200	2,119,700	2,857,000	3,801,000	4,444,000
November,	1,111,000	2,418,100	3,387,000	4,400,000	5,125,000
December,	1,253,600	2,642,000	4,376,000	5,255,000	5,877,000
	6,481,300	17,078,700	27.357,000	39,473,000	45,410,000

Total cubic feet, in four years and ten months, 135,800,000.

[E.]—*Consumption and sales of Gas in each year, in cubic feet.*

	1836.	1837.	1838.	1839.	1840.
Public Lights	978,812	1,397,687	3,013,546	6,280,654	8,028,818
Private do.	4,752,740	14,454,891	22,366,004	30,658,145	34,874,380
Works	90,000	200,000	250,000	380,000	500,000
Loss	11½ per cent.	6 per cent.	6⅔ per cent.	5½ per cent.	4½ per cent.
	659,748	1,026,122	1,727,450	2,154,201	2,006,802
Made	6,481,300	17,078,700	27,357,000	39,473,000	45,410,000

*Brief statement of facts, connected with the Explosion of the Steam Boiler in the Sash and Blind Factory of Messrs. Pike and Perry, of Middletown, Connecticut, with remarks upon the cause of the Accident.**

FROM THE SENTINEL AND WITNESS.

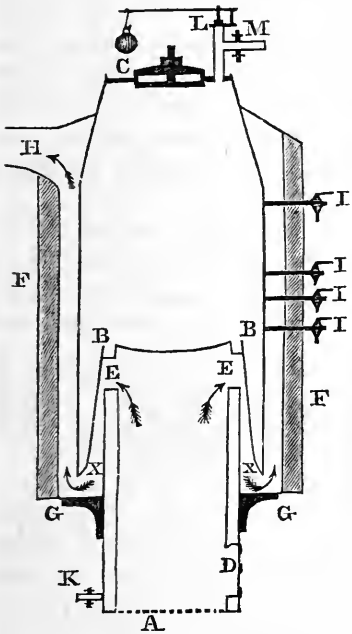
This accident occurred about half past eight o'clock on the morning of Tuesday, January 26th, 1841. The boiler which exploded was manufactured about a year ago for the Pameachy Manufacturing Company, by Guild and Douglas, of this city, and after having been in their possession about a month, it was sold to the present proprietors, who had it examined by the manufacturers, and the height of it increased, and commenced using it in June last. Since that time it has been in constant use, with the exception occasionally of a day or two. It was made of the best American iron, and was designed to be used at a pressure of about forty pounds to the square inch, but was supposed by the manufacturers, when new, to be capable of sustaining 200 lbs. to the inch without bursting.

The present engineer took charge of the engine several months since; we cannot state the precise time, but not till some time after it had been in the possession and use of Mr. Pike. And as we cannot, in giving this statement to the public—a statement which we think they have a right to demand, avoid expressing an opinion upon his conduct in connection with the catastrophe, we will take the opportunity now to say that we feel little disposition to censure him. That he is entirely free from blame we cannot affirm; but, careful as he is admitted to have been generally, as well when in the employ of others, as during his connection with Mr. Pike, it was his misfortune (as will, we think, soon be shown) to make a mistake where others, perhaps even more careful than himself, might have done the same. He affirms—and the fact so far as we know is not disputed—that some time in September or October last, during his absence a day from the shop, the person having charge of the engine allowed the water entirely to escape from the boiler, as it was found perfectly dry and leaky the next morning, and required some repairs before it could be used; and that he has been so fearful of it since that he has never ventured to risk so high a pressure upon it as he formerly did. Now it is not denied but that these facts are important, but we think other independent facts abundantly show that a very much higher pressure

* We are indebted to one of the honorary members of the Franklin Institute for forwarding this article. One of the Jury of Inquest, by whom it is drawn up, is well and favourably known for high scientific attainments. COM. PUB.

was required to produce the disrupture we have witnessed, than that to which it was ordinarily subjected. Whatever injury, therefore, the boiler may at that time have received—and we think it probably was more or less injured—we are still compelled to adhere to the opinion, that it could not have escaped its present fate, even if, at the time of the accident, it had possessed much more strength than it did when new.

But before proceeding further, in order to be understood, a description of the boiler must be given, the form of which will be seen by referring to the accompanying wood cut, which is designed to represent a section through the centre.



This boiler consisted of two parts, A, B, and B, C, each of which was six feet in height, making its whole height twelve feet. The part A, B, consisted of two concentric cylinders, one of which was placed within the other, leaving a space of two and a half inches between them to be filled with water, the cavity of the smaller constituting the furnace. At A, is the grate upon which the fire was kindled, D, the fire door, and E, E, flues, of which there were four eight inches in diameter, through which the smoke and heated air from the fire, passed, in the direction shown by the arrows. F, F, is a brick wall four inches thick, which inclosed the greatest part of the boiler, at about three or four inches distance from it, being supported by the strong cast iron plate G, G. H, flue for the smoke from the fire leading into the chimney. I, I, I, I, try-cocks, the first of which was placed six inches above the head B, B, and the others four inches apart, except the upper one, which was about a foot above the third one. The design of these was to show the height of the water, the surface of which was always to be kept above the lower, and below the upper one. These try-cocks, it will be seen, were required to be about a foot long, and were lengthened out by pieces of gun-barrel. K, pipe through which the water was forced into the boiler by the forcing pump; L, safety-valve, and M, steam-pipe, leading to the engine.

We are now prepared to understand the manner in which the explosion was produced, according to the opinion of the jury of inquest, and, it is believed, the unanimous opinion of persons who have critically examined the facts.

The explosion, as already remarked, occurred on Tuesday morning, January 26. The engine had not then been used, nor the boiler heated since the preceding Wednesday; and though the engineer, as usual, examined the boiler before kindling the fire, and, as he thought, found sufficient water in it to allow the engine to be started without pumping in any by hand, the probability is he was deceived, there being, in fact, but little in it. The probable cause of his mistake will be shown hereafter. It is not necessary to start any hypothesis to account for the fact of the water's being so low in the boiler at this time; if it was at the ordinary height when the engine was stopped on the Wednesday night previous, much of it might have escaped by a very small leak, in five and a half days.

The fire, as usual, this morning, was kindled with pine shavings, and pieces of boards, which not unfrequently produced such a blaze that it extended quite out of the top of the chimney. Being in a hurry to get the steam up, the engineer employed one of the hands to help him blow the fire a few minutes by hand, as he had done at other times. At length, by trying the safety valve, he found the pressure sufficient to commence running the engine, though not so high as they usually raised it before starting. Both pumps were started with the engine, one of which pumps the water from the well into the cistern, and the other from the cistern, into the boiler. The explosion took place about twenty minutes after the engine started.

Now if our supposition with regard to the small quantity of water in the boiler, when the fire was kindled, is correct, by the time the engine was started the parts immediately above the water must have been much heated; but would be gradually cooled as the water rose by the working of the pump, the steam in the boiler all the time increasing very rapidly. In the mean time the hot blast from the fire being driven fiercely by the blower (which forced the air in under the grate,) through the flues, E, E, would be heating intensely the part B, X, quite around the boiler, on which the water must have been suddenly dashed as soon as it rose to the edge B, to be converted into steam with explosive violence. The effect was much the same as if a quantity of gunpowder had been exploded in the boiler. The safety valve, under such circumstances, would afford no relief; and the result we have witnessed was the inevitable consequence. The engineer was probably deceived as to the height of the water in the boiler by the peculiar construction of the try-cocks, which, as we have

seen, passed through a brick wall four inches thick, and the space between this and the boiler, being nearly a foot in length. They were, of course, capable of containing considerable water, especially if they declined a little outward as it is believed they did; and this will probably account for all the water that was obtained from them that morning. If they were emptied once, being colder than the boiler, the steam, as soon as it formed, would be condensed in them again, and water might be drawn from them several times, successively. True, the engineer affirms he was aware of this, (which we are not disposed to dispute) and took the necessary precaution to avoid such a mistake, but though we give him full credit for honesty in making the statement, we think we are warranted in adhering to our own opinion. Indeed, in the hurry and bustle which confessedly occurred that morning in getting up the steam, it is not so much to be wondered at that the mistake should be made.

The rupture took place by the tearing of the iron around the edge at X, chiefly on the inside, but a part of the way the pieces separated directly at the edge, by the removal of the heads of the rivets and enlargement of the rivet holes. We are inclined to the opinion that the peculiar form of the boiler rendered it liable to yield here first, independently of the supposed fact of its being very considerably heated at the time of the accident, which must necessarily weaken it still more. The iron itself, in the opinion of competent judges, shows unequivocal indications of having been at a high temperature; and is rent and torn in such a manner as clearly to indicate the enormous force that was required to produce the effect.

The boiler seems to have yielded all around very nearly at the same time, and the part thrown off, was, therefore, thrown nearly perpendicularly upward. The slight inclination it took to the north-east may have been occasioned by its yielding a little sooner on one side than it did on the other, or by the resistance it met with in passing through the floor and roof of the building in which it was situated. On one side, four feet of the edge, where the rupture occurred, is fairly rolled up in the form of a cylinder.

The part of the boiler thus thrown from the building is computed to weigh about 1,500 or 1,600 pounds, and fell at the distance of ninety feet from its original position. So many different opinions have been expressed with regard to the height to which it rose, that means have been taken to determine it as accurately as possible, by actual measurement. Several persons saw it while in the air, some, when at its highest point, and others as it was falling; but without some mark by which to designate its actual position either at its culminating point, or some other precise point of time, it is difficult now

to ascertain the angle of elevation. One observer at the creek saw it under such circumstances, that he could scarcely mistake in identifying its true angle of elevation when at the highest point, which, by measurement, is found to give a height of 223 feet above the ground at the factory. According to the observations of others, who, however, saw it under less favourable circumstances, its greatest height would seen to have been something less than this. On the whole, we shall not exceed the truth in saying it rose from 200 to 220 feet.

Some attempt has been made to determine the height to which it rose by ascertaining the time it was in the air; and this method would be very correct if the time could be determined accurately. This, however, is very difficult, as under such circumstances it is nearly impossible for persons to form any opinion of the lapse of time, and are always prone to over estimate it. In the present instance, some persons who heard the explosion, and either heard or saw the boiler strike the ground, thought it must have been in the air a minute, others, half a minute, and others estimated it at only a quarter of a minute, but the last estimate would have given it a height (making no allowance for the resistance of the atmosphere,) of more than 900 feet. It probably was in the air about seven and a quarter seconds.

But our article is increasing to an undue length, and we refrain from adding more, except merely to say, that in preparing it we have had no personal or party purposes to serve. Our statement is made with the best of feeling towards all parties concerned. The facts stated, with the exception of one or two unimportant points, which will not be disputed, were fully established before the jury of inquest. If they do not seem to any one fully to confirm our opinion of the cause and manner of the accident, we may be allowed to remark that there are many other facts and considerations, all of which tend to confirm our views, that cannot be compressed into a single article like the present.

We have been assisted in determining the height of the boiler, by Prof. A. W. Smith.

Joseph K. F. Mansfield,
Joseph Barratt,
John Johnston,
Committee appointed by the Jury of Inquest.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

[Translated from the German, by L. Klein, Civil Engineer.]

[continued from page 173.]

LETTER X.

Cape May, New Jersey, July 29, 1839.

My ninth letter, dated from Cincinnati, contained a description of the rail roads in Belgium, and a comparison of the same with those in the United States;* in the present, I intend to give a sketch of the rail roads in the other parts of Europe.

1. *Rail Roads in Austria.*

The first rail road constructed in Austria for the transportation of passengers and freight, is that between the Moldau and Danube, or from *Budweis to Lintz;* the project for the same originated in the proceedings of the commissioners from the ten States bordering on the river Elbe, who met at Dresden in 1819, in consequence of the congress act of Vienna, and held a convention for the regulation of the navigation upon the Elbe. The free navigation upon this river commenced in 1821, and the commission at Dresden had, before its dissolution, applied to the Austrian government with the request, to regulate also the navigation of the river Moldau as far as Budweis, and to establish from that point to the river Danube, a canal or rail road, in order that goods may be transported upon this line of communication from Hamburg to the Danube, and back. In the year 1822, I was requested by the President of the Court of Commerce, to place myself at the head of this undertaking, and proceeded immediately to make the local reconnoissences. I then went to England to consult there upon the best plan of locating the rail road over the mountains which divide the waters of the Moldau and Danube, and which have an elevation of 1000 feet above the surface of the water on the one, and of 1500 feet on the other side.

At that time, the engineers in England were unanimously of opinion that every rail road which leads over a mountainous country, must be composed of horizontal or nearly horizontal sections, connected by

* This letter the author has translated into English, at the request of some friends of internal improvements, to whom the contents were shown; it was afterwards, in consideration of the important information it embraced, republished in the Journal of the Franklin Institute. See page 145, vol. xxiv.—2d series.

steep inclined planes, which are to be worked by stationary steam engines. My explanation, that I regarded a rail road, in the principles of its construction as well as its ultimate objects, as nothing more than a very good turnpike road, and therefore could, in no case, agree to the adoption of inclined planes, was entirely disregarded.

I returned from England in November, 1822, superintended, during the following two years, the necessary surveys, and obtained, on the 7th of September, 1824, from His late Majesty, Emperor Francis I, a charter for the construction and management of a rail road between the Moldau and Danube. In March, 1825, I formed a company of stockholders in Vienna, and completed, up to the end of 1828, the first thirty-nine miles of this road from Budweis to the summit. The principles upon which this section was constructed, were, to have no greater ascent than forty-four feet per mile, (1:120,) and no smaller radius of curvature than 622 feet; finally not to lose again any ascended height. As the road was intended principally for the transportation of salt, the superstructure was made of wood, with flat bars fastened upon longitudinal sills, and the adopted maximum rise was founded upon the experience, that the railway cars, as they were then constructed, commenced at that inclination on plate rail roads, to descend by their own gravity. In the fall of 1828, the section of thirty-nine miles was opened, and used, as intended, with horse power.

Plain as these principles of construction must appear to every body, and though their results realized all expectations, propositions were made for altering the same, and adopted by the directors of the company without further inquiry. I therefore once more explained in a report, published in February, 1829, the motives for adhering to the former principles, and proposed, at the same time, the introduction of light locomotive engines for carrying on the transportation on this road; but my propositions were disregarded by the directors, who prefered to have the other section of the road, from the summit to Lintz, constructed on a plan in which grades of 115 feet per mile, (1:46) were adopted for considerable distances, ascended heights were lost again, (the road was made undulating,) and curves with radii of sixty feet were frequently introduced. In the year 1832, the whole line of eighty miles in length was put in operation, and since that time, has been used without interruption, in summer and winter, although the country is covered with snow through five months in the year. The company had formerly let the transportation of salt and merchandize to a contractor, who received three kreutzer in silver per 100 lbs., on those thirty-nine miles of road, the construction of which I had superintended; this is equal to one and one quarter cents per ton, per mile; after the opening of the whole line, never less than

ten kreutzer was paid for double the former distance, or eighty miles, which is at the rate of two cents per ton per mile; and there can hardly be any body, from the engineer to the cart driver, who, in passing over this rail road, does not sincerely regret, that the principles adopted in the construction of the first half of it, were not adhered to in the construction of the other half. The company would thereby have saved at least one cent per mile for every ton of goods transported, which, for 25,000 tons, per annum, would amount to 20,000 dollars, while the additional cost of the road, if constructed according to my principles, would have been only 120,000 dollars; besides it is now impossible to use locomotive engines upon this rail road, which would be of the greatest advantage, since wood is so cheap in this section of country. There certainly exists no other rail road, neither in Europe nor in America, on which the principles of construction were so different in its two halves, and where the consequences are at the same time so apparent; and it is to be wished for the sake of instruction, that a great many persons may visit this road, and convince themselves of the results of both plans of construction.

Under these circumstances, it is surprizing that this rail road, which has cost 800,000 dollars, or 10,000 dollars per mile, has paid, since its opening in 1833, *five per cent.* annually, on the capital expended in the construction, although only 6000 passengers, and 25,000 tons of goods, (principally salt,) are conveyed annually, over the same. If 925,000 dollars, or 11,562 dollars per mile, had been expended for the construction, the profit would have been six and one half per cent., and with the application of locomotive engines, perhaps eight per cent. on the cost of construction. The stockholders of this rail road labour under the disadvantage that a part of the capital was obtained in loans on short terms, while another part was received for shares, sold below their par value; the dividends for the first subscribers are thereby lessened, and will be sufficiently large only after the debts are liquidated.

The rail road from Budweis to Lintz, was afterwards continued to the salt depots, in Gmunden, and forms now an uninterrupted line of 130 miles in length, which has been for three years in full operation. The plate rails of this road are of the same dimensions as on many of the American rail roads, upon which locomotive engines are used without difficulty; but unfortunately, the road from Lintz to Gmunden has also been constructed upon such principles as will exclude the use of locomotives for ever. The total cost of the whole rail road of 130 miles in length, is 1,170,000 dollars, or 9000 dollars per mile, which appears very low, considering the great number of bridges and frequent rock excavations. Upon the road from Lintz to Gmunden,

95,000 passengers, and 40,000 tons of goods were conveyed last year, and the income, on the same, is therefore far greater than on that from Budweis to Lintz.

In the year 1826, the construction of a rail road *from Prague to Pilsen*, in Bohemia, was commenced; it was intended for the transportation of wood from the forests of Prince Turstenberg, and of coal from the vicinity of Pilsen; the length of the projected line was eighty miles; the limited means of the company, however, allowed only the construction of the first thirty-five miles, and the rail road was then publicly sold, to pay the debts of the company. At present, the rail road is used only for bringing wood and building materials to the city of Prague. I here take occasion to remark, that I have never been in any connection with this work.

The public, in Austria, expended for the above named rail roads, of 165 miles in length, about 1,500,000 dollars, at a time when the other States of Germany had not even thought on the introduction of rail roads. By the construction of this road, which, in part, traverses very difficult sections of country, they have acquired in Austria an experience, which, if judiciously applied, must be followed by the best results; and already these rail roads have called forth those undertakings, which are, at present, executed in Austria on a much larger scale than in any other State in Europe.

The first great rail road now in progress in Austria, called "*Emperor Ferdinand's North Road*," extends from Vienna to the salt works in Bochnia, (Galitia,) and will be 310 miles in length; the section from Vienna to Brunn, of 100 miles, is already opened, and they are actively engaged in the prosecution of the work. Last year, the directors of the company estimated the cost of construction of this rail road, at 20,000 dollars per mile, it will, however, not fall short of 25,000 dollars per mile, or of 7,750,000 dollars for the whole line. As the greater part of this capital is already paid in, the whole road will undoubtedly be completed in the course of a few years. The continuation of this line to *Cracow* will then likely follow, and for a rail road from *Cracow to Warsaw*, the Russian government has already granted a charter.

The second important rail road now under construction in Austria, is that from *Vienna to Raab*, (in Hungary,) which, with the branches to Baaden, Glocknitz, and Oldenburg, will have a length of 170 miles. With the considerable amount of capital at disposal, it may be expected that this rail road will also be completed within a few years.

At this moment, there may be 300 miles of rail roads in operation in Austria, and double as many miles will be in operation in the course of three years.

2. *Rail Roads in the other German States.*

Besides the rail roads in Austria, the following have been established in Germany, for the transportation of passengers and freight, and are partly in operation:

1. The *Nuremberg and Furth Rail Road,* four and one half miles in length, though very short, gave, nevertheless, for the stockholders, the best results ever obtained on any rail road in Europe. The population of Nuremberg, is only 38,000, that of Furth, 25,000, and the number of passengers upon the rail road, were:

In 1836,	449,399;	the dividends,	19	per cent.
" 1837,	469,304;	"	17½	"
" 1838,	439,889;	"	17	"

2. The *Berlin and Potsdam Rail Road,* fourteen miles in length, has cost 1,000,000 dollars; it has been opened, partly, on the 21st of September, 1838, and in its whole length, on the 29th of October, 1838. Up to the 29th of December, of the same year, the number of passengers transported, were 102,119. This rail road will, if well managed, give very favourable results.

3. The *Leipzic and Dresden Rail Road,* of 71½ miles in length, was opened on the 8th of April, 1839. The capital stock is 3,150,000 dollars, and the company had, besides, the right to issue bank notes to the amount of 350,000 dollars. The great cost of this rail road, which will not be short of 50,000 dollars per mile, has its cause in the great unevenness of the country through which the road has been located; but on the other side, a very great traffic may be expected upon it. Although only six miles of this road were opened on the 24th of April, 1837, and afterwards merely small sections at both ends, the number of passengers has been:

From 24th of April to 31st of December, 1837, -	145,674
In the year 1838, - - - - -	365,870*

4. The rail road *from Brunswick to the Hartz,* is constructed by government, and will be thirty miles in length. The section from Brunswick to Wolfenbuttel, of eight miles, was opened on the 6th of December, 1838, and the number of passengers, to the end of that year, was 24,600.

5. The *Dusseldorf and Elberfeld* rail road, of thirteen miles in length, is undertaken with a capital of 700,000 dollars. Unfortunately, at the advice of the engineer, Robert Stephenson, an inclined plane was made in the middle of this road, which, as I have formerly observed, is in contradiction with the experience in America. On the

* According to a report lately published by the Directors, there were transported over the Leipzick and Dresden rail road, during the year 1839, 411,531 passengers, and 131,936 cwt. of merchandize, the total receipts were 262,282 dollars.

20th of December, 1838, the section from Dusseldorf to Erkrath was put in operation.

6. The *Magdeburg and Leipzic rail road* is seventy-five miles long, and constructed with a capital of 2,000,000 dollars; a part of this road will be opened in the course of this year, the remainder, in 1840.

7. The rail road *from Cologne to the frontier of Belgium*, forty-three miles in length, is located through a very difficult section of country, and its cost is estimated at 3,500,000 dollars; the completion of this road may not take place before two or three years. Cologne will then have a rail road communication with the harbours of Ostend and Antwerp, (in Belgium.)

8. The *Munich and Augsburg* rail road, forty miles in length, is constructed with a capital of 1,200,000 dollars, and will be completed in the course of the year.

9. The *Taunus rail road, from Frankfort to Mentz*, and Wiesbaden, is undertaken with a capital of 1,300,000 dollars, and will be twenty-six miles in length; it will likely be completed in the spring of 1840.*

10. In the Grand Duchy of *Baden*, a very extensive rail road is now under construction, through the whole length of the State, at the expense of the government, and as, at the same time, a rail road is constructing through Darmstadt, there will be, within a few years, a continuous rail road from Frankfort, on the Main, to Basle, in Switzerland.

There are some other small rail roads in different parts of Germany, upon which, however, nothing but coal, iron ore, &c., is transported.

The cost of construction, and even the length of the above named rail roads, cannot be accurately stated, as scarcely any of the lines is entirely completed, or, at least, buildings, locomotives, cars, &c., are still wanted on them. The average of the cost of the several rail roads, as above stated, is 47,000 dollars per mile; but when they are all in full operation, their cost will be found to amount to 50,000 dollars per mile; and perhaps to more. The cost of a mile of rail road, with a single track, in Germany, is, therefore, two and a half times greater than in America. If we take into consideration the extremely low wages of all classes of workmen, in Germany, but at the same time, also, the greater unevenness of the country, and compare both with what they are in America, we cannot but regard the works in Germany as very expensive, and I must, after mature deliberation, refer again to those causes by which the American rail

* A part of this road, from Frankfort to Hoechst, was opened in September, 1839, and the whole line in April, 1840. Up to the 1st of July, the number of passengers were 281,510, yielding an income of 50,000 dollars.

roads are so much cheaper, and which were stated in my fourth letter. It is for the fear of a too great expenditure, that no other rail roads are now undertaken in Germany, and that so many good and useful projects were abandoned. Amongst the projected rail roads, with the locality of which I am somewhat better acquainted, I mention the *Rhine and Weser*, the *Berlin and Stattin*, and the rail road from *Berlin to Frankfort, on the Oder*. These lines might, with the assistance of the great experience acquired in America, be constructed for such sums as would insure a good profit to the stockholders.

3. *Rail Roads in France.*

The most extensive rail road line in France, is that from *Lyons to Roanne*, which was constructed by three companies, and is thirty-eight lieues in length; the Epinac rail road is six and one half lieues, and the Paris and St. Germain rail road four and three quarter lieues long, while the total length of the other rail roads in operation, will hardly amount to eleven lieues; France has, therefore, at present, only sixty lieues, or 150 miles of rail roads in operation.* The most expensive of these roads is that from *Paris to St. Germain*, which is only 18,400 metres, or $11\frac{1}{2}$ miles in length, and has cost 14,860,000

* The following is a list of the rail roads in France, at the close of 1839:

a.) Rail roads completed.	Length in metres.		Miles.
From St. Etienne to Andrezieux,	22,000	or	13,66
" St. Etienne to Lyons,	58,000	"	36,02
" Andrezieux to Roanne,	67,000	"	41,61
" Nimes to Beaucair,	24,000	"	14,90
" Montbrison to Montrond,	15,500	"	9,62
" Paris to St. Germain,	18,400	"	11,43
" Paris to Versailles, (right bank,)	18,572	"	11,53
" St. Vaast to Denain,	8,900	"	5,53
" Cette to Montpellier,	27,000	"	16,77
" Mulhouse to Thann,	19,660	"	12,21
" Creusot to the Canal du Centre,	10,000	"	6,21
" Villers Cotterets to Port aux Perches,	8,155	"	5,06
" Epinac to Bourgogne Canal,	28,000	"	17,39
" Alais to la grand Courle,	18,000	"	11,17
Total,	343,187	"	213,11
b.) Rail roads in progress, from Nimes to Alais,	46,319	"	28,77
From Paris to Versailles, (left bank,)	18,630	"	11,57
" Bordeaux to La Teste,	51,000	"	31,68
" Abscou to Denain,	5,940	"	3,69
" Strasbourg to Basle,	140,000	"	87,00
" Paris to Orleans,	120,000	"	74,53
	381,889	"	237,24

francs, or, per mile, 242,000 dollars. The part within the city of Paris, was, of course, the most expensive, but even after deducting the length and cost of this section, we find 165,000 dollars as the cost per mile, for the other part of the road, with a double track. Of the *Lyons and St. Etienne* rail road, which has also two tracks, the cost per mile, was about 70,000 dollars.

Upon the Paris and St. Germain rail road, 1,375,396 passengers were conveyed, from the 26th of August, 1837, up to the 25th of August, 1838, and the total receipts have been 290,834 dollars, or, per mile of road, 25,448 dollars; this gross income, per mile, is eight times as great as that upon the American rail roads, where it averages only 3075 dollars; but compared with the capital of construction, the gross income, in America, is fifteen per cent., and on the Paris and St. Germain rail road, only ten per cent. The French rail roads pay like the diligences, (stages,) ten per cent. of the gross income, as a tax to the State; the expenses of managing these roads, will, therefore, not amount to less than two thirds of the gross income, and the Paris and St. Germain rail road will hardly yield an interest of four per cent., if the traffic does not materially increase.

These are the causes why the rail roads projected in the spring of 1838, from Paris to Havre, from Paris to Orleans, and from Strasburg to Basle, for which the concessions were given by the Chambers, find so little support from the public, in France, that these projects will, it is likely, be entirely abandoned. The great mass of the population in France, is poorer than that in Belgium; and as the Belgian rail roads, with an average cost of 45,000 dollars per mile, yield only five per cent. on the capital of construction, the rail roads in France ought not to be constructed for more than 30,000 dollars per mile, if the capital of construction shall yield five per cent. interest. But to arrive at this, the principles of construction, hitherto followed, as also the now existing revenue laws in France, so injurious to every enterprize, require a thorough reform.

4. *Rail Roads in Holland.*

If the establishment of the rail roads in Belgium, belongs to the remarkable events of the age, it is still more the case with the rail roads in Holland. This interesting country is known to be intersected by navigable canals in every direction, and nowhere are better and more carefully maintained turnpike roads to be found. Nevertheless, the construction of a rail road from *Amsterdam to Harlaem* was commenced two years ago, and was nearly completed, when I visited Holland, in May, 1838, with the intention to inspect the large works of draining, which were undertaken near Gouda. The con-

struction of this rail road is the more remarkable, as there is between Amsterdam and Harlaem, a canal, upon which passenger boats are running, and close to it, a turnpike road. A width of track of four feet eight and one half inches, like that of the English railways, was intended for this rail road; but when it became known that the St. Petersburg rail road has a width of six feet, and the rail road from London to Bristol, even of seven feet, it was established by a decree of the government, that all the rail roads in Holland shall have a clear width between the rails of two metres, or six feet six and three quarter inches.

For a second rail road, from *Amsterdam to Arnheim*, along the Rhine, the concession was given by His Majesty, King William, with a guaranty not before heard of in any work of this kind; the King declared himself ready to guaranty to the stockholders, with his own private property, a dividend of four and one half per cent. per year. It is unnecessary to mention, that the whole capital was instantly subscribed.

[TO BE CONTINUED.]

Extracts from the Second Report of the Directors of the New York and Erie Rail Road Company, to the Stockholders, February 3rd, 1841. *Signed, by order of the Board of Directors, by* ELEAZAR LORD, ESQ., *President of the Company.*

CONTINUED FROM PAGE 194.

Of the Probable Income of the Road.

Instead of proposing simply an estimate of the probable number of passengers on this road, connected as it is, at its extremities, with the greatest sources and facilities of travel in the country, and throughout its whole extent, with tributaries from the right and left, or of the quantity of tonnage it may command, it seems appropriate to observe, that it occupies a route which is exempt from all hazard of competition; that it will accommodate an extent of country far larger than that which supplies the business of the Erie canal; that it is adapted to the object of tonnage as well as to that of travel; that besides the ordinary products of agriculture and manufactures, it will have large resources of business in the transport of minerals and lumber; and that the population within such distance of it, as to be relied on for its support, will not be less numerous than that which contributes to the toll, freight, and travel, on the Erie canal, and the works near its borders.

To illustrate the consideration last above mentioned, the following statements are submitted in the belief that the results will justify the utmost confidence in the productiveness and value of the work.

Statement of the population, by the census of 1840, of the counties traversed by the road, and of adjacent counties, and parts of counties,

to which it will be the most convenient route of communication with the city of New York.

Counties through which the Line extends.

Rockland, - - - -	11,874	
Orange, - - - -	50,733	
Sullivan, - - - -	15,630	
Delaware, - - - -	35,363	
Broome, - - - -	22,348	
Tioga, - - - -	20,350	
Chemung, - - - -	20,731	
Steuben, - - - -	45,992	
Alleghany, - - - -	40,920	
Cattaraugus, - - -	28,003	
Chatauque, - - - -	47,641	
		340,385

Adjacent Counties in the State of New York.

Two-thirds of Otsego, - -	44,248	
Chenango, - - - -	40,778	
Cortland, - - - - -	24,605	
Tompkins, - - - -	38,113	
One-third of Cayuga, - -	16,787	
One-third of Seneca, - - -	8,289	
Yates, - - - - -	20,442	
One-quarter of Ontario, - -	10,875	
One-half of Livingston, - -	17,855	
One-half of Genesee, - - -	28,305	
One-quarter of Erie, - -	15,788	
		266,085
		606,470

Adjacent border counties of Pennsylvania, viz:—Erie, Warren, McKean, Potter, Tioga, Bradford, Susquehanna, Luzerne, Wayne, and Pike, and parts of some others; and in New Jersey, parts of Sussex, Passaic, and Bergen, estimated at - - - - - -	230,000
	836,470
Under the influence of the construction and use of the road, the increase in the above counties, in the next five years, may be safely estimated at 20 per cent. or - -	167,294
	1,003,764

The foregoing statement is made with reference to the state of things when the road is completed, and comprises considerable numbers within this State, which at present contribute to the support of the Erie canal, through the Chenango and Chemung canals, and by various land routes; for all which there is room for adequate allowance in the ensuing calculations.

By the census of 1830, it appears that the number of inhabitants in the above mentioned counties, and parts of counties, in this State, was - - - -	477,823
Increase in ten years, 27 per cent., or - - -	128,627
	606,450

The increase in the State at large, during the same period, excluding the city of New York, was 23¼ per cent.; and in the city of New York, 50½ per cent.

In the eleven counties traversed by the road, the number of inhabitants in 1830, was - - - - -	262,433
Increase in ten years, 30 per cent., or - - -	77,952
	340,385
The number of acres of land taxed in the aforesaid counties, and parts of counties, in this State, in 1839, was	8,781,765
The number of acres taxed in the canal counties, and parts of counties, represented in the following statement, was, in 1839, - - - - - -	6,631,955

Statement of the population in 1840, of the counties which are traversed by, and other counties and parts of counties, which now are, and will, it is assumed, continue after the road is completed, to be tributary to the Erie canal.

Schenectady, - - -	17,233	
One-third of Otsego, - - -	17,124	
Montgomery and Fulton, - -	43,839	
Herkimer, - - - -	37,378	
Oneida, - - - -	85,327	
Madison, - - - -	40,067	
Oswego, - - - -	43,820	
Onondaga, - - - -	67,914	
Two-thirds of Cayuga, - -	38,575	
Two-thirds of Seneca, - - -	16,579	
Wayne, - - - -	42,160	
Three-fourths of Ontario, - -	31,876	
Monroe, - - - -	51,912	
One-half of Livingston, - - -	17,855	
Orleans, - - - -	25,015	
One-half of Genesee, - - -	28,305	
Niagara, - - - -	31,114	
Three-fourths of Erie, - - -	46,615	
		677,708

The number in the same counties, and parts of counties, in 1830, was - - - - - - -	548,205
And in 1835, the number was - - -	646,197
Increase in ten years, from 1830 to 1840, 23½ per cent.	
Increase in five years, from 1835 to 1840, 5 per cent.	
With an increase of 5 per cent. in the next five years, the number will be - - - - -	711,593

If to 677,708 be added the inhabitants of the city and vicinity of

Albany, say 32,292, making 710,000, an increase of 7 per cent. thereon in five years, will make an aggregate, in round numbers, of 750,000.

The very moderate increase above noticed, of 5 per cent., between 1835 and 1840, is most probably to be accounted for, by supposing that the effect of the canal in drawing population within reach of its facilities, and in enhancing the price of farm lands from four or five, to fifty, eighty, or a hundred dollars per acre, according to position, had been realised prior to 1835; while the extraordinary increase of thirty per cent. in ten years, in the counties on the line of the road, indicates that the anticipation of that work, added to the very low price of lands in those counties, had induced emigration thither.

If to the population to be immediately accommodated by the rail road as above stated, viz: - - -	836,470
be added that of the city of New York, in 1840, viz:	312,832
and that of Brooklyn and vicinity, say - -	45,718
The aggregate will be - - - -	1,195,020
The increase of which, in the next five years, supposing the road to be completed and in full operation within that period, may be safely estimated at 25 per cent., making in round numbers - - -	1,500,000

It is, therefore, abundantly manifest that a population not less, but more numerous than that by which the canal and its route is used, is to be accommodated, and relied on for the support of this road.

Now the tolls annually collected on the Erie canal and its branches, exclusive of the Champlain canal, amount in round numbers, to - - - - -	$ 1,500,000
The cost of freight on the canal is, at least, three times as much as the tolls, or - - - - - -	4,500,000
The amount of fares paid by the population using the canal for passage in boats, and on the rail and other roads along its route, cannot be estimated at less than three dollars each per annum. The population using the canal route at the present time, may be estimated with sufficient accuracy by adding to the number in the canal counties as above stated, viz. in 710,000, for those from other counties and parts of counties, who, through branch canals and otherwise, now use the route of the Erie canal more or less, both for travel and transport, a number equal to about one half of the 606,450 assigned to the rail road within this State, making in round numbers $ 1,000,000; which at three dollars each, amounts per annum, to - - - - - -	3,000,000
Total, - - - - - -	$ 9,000,000

which is equal to an average of nine dollars each, per annum, for travel and transport on that route, or about 12 per cent. of the value of the commodities transported.

In 1839, 1,435,713 tons were transported on the canals, valued at $ 73,399,764, on which the tolls received amounted to $ 1,616,382, of which $ 113,753 were collected on the Champlain canal.

The tolls actually collected on the canal, being the basis of this estimate, and the results being, after large allowances, sufficient to justify the inferences to be made from them, it is immaterial whether the numbers stated as now using the canal, or the rates of fares paid, be exact or not. No reason is perceived why it may not be safely taken as a basis of calculation with reference to the rail road and Southern tier of counties. The inhabitants of those counties are not less industrious or less enterprizing than those of the counties which border the canal. Their lands, for all the purposes of agriculture, with exceptions in respect to wheat, are superior to those of the canal counties; their climate is more uniformly salubrious; and in their rivers, their forests, and their minerals, the difference is still more widely in their favour. If there be a reason, it is not apparent, why they should not have occasion to travel as much, and as far as their Northern neighbours, to procure for themselves a like quantity of supplies, and to pay for them by sending their products to market; or why they should not be able and willing to pay as much annually, for travel and transport, if favoured with facilities adapted to all their objects, interests and wishes, and available from the Atlantic to the lake, in winter as well as summer. If the products of their agriculture are at present less, their lumber and their minerals are far more abundant. The railway will, to say the least, furnish them facilities of travel and transport as much more eligible and convenient than any others within their reach, as the canal and the road, along its route, do those using and supporting them. For through passengers passing West from the city of New York, and East from the lakes and Western States, the prospects of the road cannot be well deemed inferior to those of the canal route, whether distance, time, expense, or comfort be most regarded.

There would seem, then, to be nothing very extravagant in anticipating for this road, which will be competent to as much business, and combines all the objects of the canal and the rail and other roads on its borders, an amount of income not vastly disproportioned to the amount paid for tolls, freight, and travel on that route, as above represented.

To those, however, who may think it most prudent to suppose the inhabitants of the Southern counties to have fewer wants than their neighbours, less ability to supply them, and less occasion and leisure for travel, it may be more satisfactory to estimate their payments for the same objects, at six, or at four and a half, instead of nine dollars each, per annum. At six dollars each for 800,000, the amount would be $4,800,000. At four dollars and fifty cents, it would be $3,600,000.

Supposing then that a single track of the road finished in the best manner, with a heavy edge rail, and competently furnished with engines, cars, and all the requisite appurtenances, should cost $9,000,000, the above estimate of six dollars for each inhabitant, deducting one-third, or $1,600,000 for expenses, which is deemed more than sufficient for such a road, would give an annual net income, on the cost, of thirty-five per cent. At four dollars and fifty cents each, the net income would be over twenty-six per cent. per annum. If only three

dollars each be assumed, which would require the supposition that the travel and business of this population, would be but one-third as much as that on the route of the canal, the net income, after deducting one-third for expenses, would amount to about eighteen per cent. per annum.

To judge of the claims of any such undertaking, and especially of rail roads, because they offer the greatest facilities for travel, and likewise for transport, when properly constructed for that object, it is essential to inquire, first and chiefly, to what number of people will the work in question afford the most satisfactory means of travel and business. This may involve two subordinate inquiries; one, whether, and to what extent, the route is exposed to competition; the other, as to the tendency of the work to augment and multiply the employments and business of those who are relied on for its support, and to attract farther accessions to the population.

Where there are people enough for its support, a road adapted to their purposes, and so conditioned as to command their patronage, will, of course, be productive. The number of people to be served is, in connexion with the length of the road, a far safer basis of calculation than any general or theoretical estimate of passengers and tonnage. There may be a great difference on different routes in the variety and extent of the employments and business of the people; and a more numerous population may be required on some routes than on others, to afford daily a sufficient number of passengers, in addition to their tonnage, to support a road. On a route through a salubrious and inviting country, occupied by a prosperous and increasing population, and affording scope and objects for ten times their numbers, a railway is a far safer investment than on a route which, though equally populous at the outset, presents no new objects of enterprise, or inducements to immigration. On a road long enough to yield, on an average, five dollars for each passenger, two hundred passengers a day, with their tonnage, would probably yield a better income on the same capital, than twenty-five hundred per day, on a short road, yielding but fifty cents a passenger. A road requires a given number of passengers yearly, with their tonnage, to render it productive. If there are on its route people enough, their character, circumstances and employments being considered, to supply that number of passengers, and if growing numbers and patronage are in the given case to be relied on, in connexion with the use and influence of such road, its success is certain.

Such a case is presented by this road. There is no mode of estimate or calculation on such a route, occupied by such a population, that will not justify all that need be claimed or presumed for this.

One consideration has, however, been omitted, which merits notice, and which, from its important bearing on the subject, did not escape the attention of the intelligent and practical men who have added most liberally to the subscriptions of the past year—namely, that on all that portion of the cost of the work which is discharged by capital borrowed, the annual dividend is limited by the rate of interest on the loan—consequently the dividends on the company's

stock will be larger in proportion as the earnings of the road exceed the rate of interest on the loan. Thus, if the income of the road is equal to ten per cent. on its cost, it will pay six per cent. on two-thirds of the amount, and eighteen per cent. on the balance.

Aware of the operation of this method, and of the security it gives at once to stockholders and to the lenders of capital, railway companies in England, in cases where the density of the population insures an abundant income, even on roads costing ten to twenty times as much per mile as this will cost, and where they find no difficulty in disposing of their stock to any required amount at a premium, limit the issue of shares to a portion of the expenditure, and supply the balance by loans.

It may still be gratifying to some to have before them an estimate of the number of passengers required at a given charge for fare to support this road.

If then there should be, including way and through passengers, a number equal to one hundred and five through each way per day, making for both ways sixty-six thousand a year, at twelve dollars each for four hundred and fifty miles, or about two and a half cents per mile, the receipts would amount to - - - - -	$792,000
And if the interest on $6,000,000, at 5½ per cent., be deducted, viz. - - - - - -	330,000
The remainder - - . - -	$462,000
will divide over 15 per cent. on $3,000,000 of stock.	
At eighteen dollars each, or four cents per mile, the balance will divide 28 per cent. on $3,000,000.	
If the number of passengers be equal to one hundred and fifty through each way per day, or one hundred thousand a year, the receipts at twelve dollars each for fare, would amount to - - · - - -	$1,200,000
and interest be deducted as before - -	330,000
The remainder - - - - - -	$870,000
will divide 29 per cent. on $3,000,000 of stock.	
And at eighteen dollars each, the balance will divide 49 per cent. on the stock.	
Should the city of New York, the counties on the route, and the regions beyond, furnish passengers equivalent only to fifty through each way per day, or thirty-three thousand a year, the receipts at eighteen dollars each, or four cents per mile, the rate usual on other roads, would amount to	$594,000
interest being deducted as above - - -	330,000
The balance - - - - - -	$264,000
will divide 9 per cent. on $3,000,000.	

As an illustration of the matters involved in these estimates, it may be observed that on the Utica and Schenectady railroad, seventy-eight miles in length, the number of through passengers, in 1839, was - - - -	95,776
and of way passengers - - - -	86,823
Total - - - - -	182,599

equal to 125,102 through passengers; the fare through being three dollars, or a fraction short of four cents per mile. It is understood that the passengers transported on that road are estimated at not more than one-fourth of the whole number that pass between Utica and Schenectady, on the canal and otherwise, per annum.

The expenses of the year amounted to less than 30 per cent. of the receipts. The balance, after deducting all expenses, amounted to more than 15 per cent. on their capital. Had half of their capital been borrowed at 6 per cent., the earnings of the year, after paying the interest on the loan, would have divided 25 per cent. on the stock; or paid off the loan in four years of like receipts; or divided 10 per cent. per annum, and paid off the loan in six years.

The number of through passengers, as stated above, divided by the number of miles in the road, gives an average equal to 1604 passengers per mile yearly, 134 per mile per month, and 31 per mile per week.

100,000 through on this road would give 224 passengers per mile yearly, 19 per mile per month, and 4½ per mile per week.

66,000 through would give 147 passengers per mile yearly, 12 per mile per month, and 3 per mile per week.

33,000 through would give 73 passengers per mile yearly, 6 per mile per month, and 1½ per mile per week.

On the Boston and Worcester road, forty-one miles in length, the average in 1839 would be 2195 passengers per mile yearly, 183 per mile per month, and 42 per mile per week.

On the Boston and Lowell, twenty-six and a half miles in length, in 1838, 4905 passengers per mile yearly, 409 per mile per month, and 94 per mile per week.

On the Camden and Amboy, sixty-one miles in length, in 1839, 2984 passengers per mile yearly, 249 per mile per month, and 57 per mile per week.

Utica and Syracuse, fifty-three miles in length, in 1839, 2302 passengers per mile yearly, 192 per mile per month, and 44 per mile per week.

The number of way passengers on the Utica and Schenectady railroad amounted, in 1839, to 86,823.—The gross revenue derived from them was $87,979 57, amounting to $1.01 for each individual; and as the charge for a through passenger is three dollars, it is seen that the way passengers traveled, on an average, one-third the length of the road. It may be assumed as nearly self evident, that in a country occupied by a population distributed evenly over its surface, and having a uniformity of character and pursuits, the railroads which traverse it will receive numbers of way passengers proportional to their

lengths; that is, a straight road two hundred miles long will have twice as many way passengers as a road one hundred miles long. If we apply this principle to the case of the New York and Erie railroad, we may estimate the number of its way passengers from that on the Utica and Schenectady road, in the following manner, viz:

Miles. Miles.
78 : 446 : : 86,823 : 496,449 = number of way passengers on the New York and Erie railroad. If we suppose the distance traveled by the above number of persons to be the same in proportion as on the Utica and Schenectady railroad, the average journey for each will be one hundred and forty-eight miles. At four cents per mile the sum paid would be $ 5.92, and the amount per annum received from all the way passengers would be $ 2,938,978.08.

To illustrate this view of the subject still farther, we will make a similar estimate from data furnished by the Utica and Syracuse railroad. The length of this work is fifty-three miles; the number of way passengers in 1839 was 55,802, who paid on an average seventy-three cents each, the price for a through passage being two dollars. By extending the calculations as above, we shall find that the number of way passengers on the New York and Erie railroad would, at the same rate, be 469,579, and the sum received from them, $ 3,056,959.

The amounts obtained in these calculations agree sufficiently to show that with regard to the railroads cited, the rule that the numbers of way passengers are as the lengths, holds good.

The mean of the two results is about $ 3,000,000, from which, if we were to deduct one-third for expenses, we would have a net receipt of $ 2,000,000 on way passengers alone; equal to 22 per cent. on the capital; or if two-thirds of the cost of the work were defrayed from loans, at 5½ per cent., the income on the remaining $ 3,000,000 of stock would be 55 per cent. per annum. In other words, if the New York and Erie railroad shall receive as many way passengers in proportion as the Utica and Schenectady, and Utica and Syracuse railroads, the net earnings might be more than sufficient to pay 5½ per cent. on $ 6,000,000 of loans, and 50 per cent. on $ 3,000,000 of stock, and this without taking into account the profits on through passengers, on freight or on the transportation of the mail.

Nothing can illustrate more forcibly than this the advantages which long roads possess over short ones. The results obtained may seem extravagant, and it is not intended to be asserted that they will from the first be realized; but when it is remembered that the Utica and Schenectady railroad has, to the north of it, a country which, as yet, yields very few passengers, and that on the south side it is in immediate contact with the Erie canal, which, during seven months of the active portion of the year, divides with it the way business, and that the Utica and Syracuse railroad, having the same competition with the canal to sustain, has also the inconvenience of being constructed for nearly half its length across swamps which are at present uninhabitable, whereas the New York and Erie railroad is every where free from these disadvantages, it cannot be deemed unreasonable that we

should expect to profit to a very considerable extent from the principle above set forth.

The Boston and Lowell road is one of the best in the country, and is worked as cheap, or cheaper, than any other, in proportion to its length. But it is short, and notwithstanding its heavy business, both in passengers and tonnage, pays but about nine per cent. per annum on its cost.

Of the railroad stocks in England, which are offered for sale, as quoted in the London Mining Journal, Railway and Commercial Gazette, of the 26th of December, 1840, all those which appertain to railways, of which the length is thirty miles or more, and which have been completed and in operation one year or more, are at a premium, viz:

Stockton and Darlington, 38 miles, including branches; opened, 1825; price, £275 per £100 paid up, premium, 175 per cent.
Liverpool and Manchester, 31 miles; opened, 1830; price, £185 per £100 paid up; premium, 85 per cent.
Grand Junction, 82½ miles; opened, 1837; price, £212 per £100 paid up; premium 112 per cent.
London and Birmingham, 112 miles; opened, 1838; price, £169 per £90 paid up; premium 87½ per cent.
London and Southwestern, 76¾ miles; opened, 1838 and 1840; price £54 per £30 paid up; premium, 40½ per cent.
Great Western, 117½ miles, of which 63½ are finished; opened, 1838 and 1840; price, £89 per £65 paid up; premium, 37 per cent.
New Castle and Carlisle, 61 miles; opened, 1839; price, £105 per £100 paid up; premium, 5 per cent.

The stocks of a number of other roads which exceed thirty miles in length, up to one hundred and twenty-six miles, are quoted at various rates below par, but most of them are but partially constructed, and none of them had been completed and opened prior to 1840.

Of the numerous roads which are less than thirty miles in length, the stocks, without exception, are quoted below par.

Analogous to this, is the experience on this side of the Atlantic. Though the cost of roads here is comparatively small, and their character as to routes, grades, curves, and superstructure, is quite various, it is believed that not more than two or three that are forty miles or more in length, and have been finished and in use twelve months, are unproductive; among which, the only one in New England, or New York, is that from Stonington to Providence. Their earnings vary from 6 to 15 per cent. Some shorter roads are known to be productive, but it is deemed quite safe, and due to the subject, to state that of the roads which are completed and in use, those which are not productive are short ones.

The report of the Western railroad corporation of Massachusetts, dated March, 1840, states that the net income of the railroads, finished in that Commonwealth, averages over 8 per cent. per annum on their cost.

In 1839 the net income of the Utica and Schenectady road was 15 per cent.; of the Utica and Syracuse, 14 per cent.; of the Camden and Amboy, 13¾ per cent.

The foregoing estimates of passengers on this road, are made on the supposition that the freight both ways would pay the repairs and all other expenses, which may be taken at one-third of the receipts, or assuming the largest of these estimates, at $400,000 a year.

On the Erie canal, in 1839, about 160,000 tons of merchandise, products of animals, seeds, &c., were transported, of the value of $45,000,000, as stated in the report of the commissioners; and about 340,000 tons of manufactures, vegetable food, &c., exclusive of lumber, valued at $17,000,000, making 500,000 tons of the above mentioned articles, valued at $62,000,000.

The 160,000 tons of merchandise averaged in value $280 per ton and would, it may be reasonably presumed, be transported on a railway properly constructed for tonnage, in preference even to an adjacent canal, on account of its value, the difference of time occupied in its passage, certainty of calculation as to its arrival, less risk of damage, convenience in respect to the engagements and affairs of those owning it, and other considerations of more or less force in different cases.

The 340,000 tons of manufactures, &c., averaged in value about $ 50 per ton, and would assuredly be transported on a railway on the shortest route to market were there no canal on such route.

Let it then be supposed, that of the above descriptions of articles, quantities should be transported on this road, equal only to 100,000 tons through per annum, and that the rate of profit on the transit of them should be one per cent. per ton per mile, the net receipts in such a case would be $450,000, or more than enough to defray the supposed amount of annual expenses.

Or if by being in operation five months of the year more than the canal, 50,000 tons of merchandise for the interior of this and the western and southwestern states, should be transported over the road at a profit of two cents per ton per mile, the like sum of $450,000 would be received.

It is therefore deemed as plain as success elsewhere or here can make it, that excluding all reliance on lumber, coal, and other minerals, there is room for the highest confidence of an abundant income. It is believed, however, that when the road is in full operation, from 100,000 to 200,000 tons of coal, and a like quantity of lumber, will be transported on it, on an average 150 miles; and that the number of passengers and the whole amount of tonnage will very far exceed the highest of the preceding estimates.

Architecture.

On Glass as applied to Architecture.—Extract from a Lecture on the Architecture of the Middle Ages, delivered before the Franklin Institute, by T. U. Walter, *Professor of Architecture, December* 10, 1840.

"The first ancient writer by whom any mention is made of glass as an artificial substance, is Theophrastus, who wrote about 300 years before Christ; he describes it as having been made of the sands of the river Belus, and seems to have had considerable knowledge of its nature. About a century later, we have a description of the celebrated *sphere* of Archimedes, which, if the account of it be true, goes to show that the art had then attained to considerable perfection.

Lucian speaks of drinking glasses, and Plutarch, Lucretius, Virgil, Horace, Strabo, Seneca, and Pliny, all mention glass; indeed Pliny, who wrote in the 77th year of Christ, gives a full description of the way in which it was then manufactured; he says that some forms were brought into the required shape by blowing with the breath, some were ground on a lathe, and others were embossed—Sidon, he tells us, was formerly famous for these manufactures, and *specula,* or looking-glasses, were first invented there. He further remarks, that no substance was more manageable in receiving *colours,* than glass, and that it might be cut, or engraved upon by diamonds. The Apostle Paul also alludes to glass, in his first letter to the Corinthians, written about the year 57, and the language he uses clearly indicates it to have been a substance through which objects could not be discerned with distinctness.

We have no positive authority relating to the use of glass for *windows,* earlier than the close of the third century. St. Jerome, who wrote in 422, speaks of windows formed of glass melted and cast into thin plates; and in the year 571, Gregory of Tours alludes to the devastations committed on the windows of churches, by the ravages of war. Johannes Philoponus, who is supposed to have written about the same time, speaks of the panes of glass being fastened in the windows with plaster.*

Felibien, in his "*principes de l'architecture,*" says that the first attempts at ornamenting windows with figures, were made by arranging glass of different colours, like mosaic, and that the beautiful effect thus obtained, led gradually to the art of infusing various tints into each pane, so as to produce compositions of any required design.

Fortunatus, who lived towards the end of the sixth century, speaks

* Rees' Cyclopædia.

in glowing terms of the painted glass in the windows of the church of Notre Dame, at Paris; and Benedict Biscopius is said to have imported the art into Britain in the year 675.

Stained glass was not, however, connected with architecture to any great extent, until the reign of the third Henry in England, in the thirteenth century, and it reached its zenith under the kings of the house of York, in the fifteenth century.

A popular idea prevails that the art of staining glass was lost, but such is not the fact. When architecture began to decline, under the Tudor family, all the arts connected with it declined also, as a natural result. Felibien, who wrote as long ago as the year 1699, says, that in ancient stained glass, some very beautiful and very lively colours are seen, which are not now to be found; it is not, however, that the invention is lost, but because persons will not incur so great an expense, or take the same pains to make them, that they formerly did.*

Dallaway says, very plainly, that the idea of the art having ever been lost, "*is a vulgar error*," it is practised at the present day as perfectly, and as beautifully, as in any preceding age.†

From this cursory glance at the introduction of glass in building, we find that architecture went through all its earliest stages in the east, attained the zenith of its glory in Attica, and sunk in ruin with the city of the Cæsars, before glass was used at all as a material for keeping out the weather, and transmitting light; hence *classic* architecture ran its whole course without any influence whatever from this invention; while, on the other hand, *Gothic* architecture depends for *its* character almost exclusively upon it. To the introduction of glass in building, may, therefore, be attributed much of the wide difference which exists between classic and gothic architecture."

Franklin Institute.

Minutes of the Board of Managers.

At a meeting of the Board, held at the Hall of the Institute, January 17th, 1841,

Mr. James Henry Bulkley was elected Chairman, and

Messrs. Henry Troth and John S. Warner, Curators, for the ensuing year.

At a meeting of the Board, held February 17th, 1841, the Chair-

* Felibien's principes de l'architecture, p. 182.

† Dallaway's Discourses upon Architecture in England, p. 63.

man nominated the Standing Committees agreeably to the By-Laws. On motion—Alfred L. Elwyn, M. D., was added to the Committee on the Library; Professors Jas. C. Booth and Jno. F. Frazer to the Committee on the Cabinet of Minerals; Messrs. Thomas S. Stewart and John M'Clure to the Committee on the Cabinet of Models; Professors James C. Booth and John F. Frazer and Mr. Joseph Saxton to the Committee on the Cabinet of Arts and Manufactures; Messrs. Samuel V. Merrick and Matthias W. Baldwin to the Committee on Publications; Professor Henry D. Rogers to the Committee on Instruction; Professor Roswell Park, Robert Hare, M. D., John K. Mitchell, M. D., Mr. Joseph Saxton, Mr. Andrew M. Eastwick, and Professor John C. Cresson to the Committee on Monthly Meetings; Gouveneur Emerson, M. D., Mr. Sears C. Walker, and Professor Roswell Park to the Committee on Meteorology; when the Committees were appointed as follows:

On the Library.

Henry Troth, *Chairman*,
Isaac Hays, M. D.,
Isaac P. Morris,
Ambrose W. Thompson.
Thomas U. Walter,
Alfred L. Elwyn, M. D.

On the Cabinet of Minerals.

Charles B. Trego, *Chairman*,
Isaiah Lukens,
Abraham Miller,
Samuel Hufty,
Henry D. Rogers,
James C. Booth,
John F. Frazer.

On the Cabinet of Models.

Isaac P. Morris, *Chairman*,
John Agnew,
Andrew M. Eastwick,
Thomas U. Walter,
John H. Towne,
Thomas S. Stewart,
John M'Clure.

On the Cabinet of Arts and Manufactures.

James C. Booth, *Chairman*,
Alexander Dallas Bache,
Charles B. Trego,
John Struthers,
John H. Towne,
Edwin Greble,
John F. Frazer,
Joseph Saxton.

On Publications.

John C. Cresson, *Chairman*,
Isaac Hays, M. D.,
Samuel V. Merrick,
Alexander Dallas Bache,
Matthias W. Baldwin,
Isaac P. Morris,
Ambrose W. Thompson.

On Premiums and Exhibitions.

Thomas Fletcher, *Chairman,*
John Struthers,
John Agnew,
John S. Warner,
John Gilder.

On Instruction.

Alex. Dallas Bache, *Chairman,*
Frederick Fraley,
John Wiegand,
Charles B. Trego,
Henry Troth,
Henry D. Rogers.

On Monthly Meetings.

Roswell Parke, *Chairman,*
Alexander Dallas Bache,
Robert Hare, M. D.,
John K. Mitchell, M. D.,
Joseph Saxton,
Andrew M. Eastwick,
William H. Carr,
John C. Cresson,
George Taber,
John H. Towne,
James Hutchinson.

On Meteorology.

Gouveneur Emerson, *Chairman,*
John C. Cresson,
Sears C. Walker,
Henry D. Rogers,
Roswell Parke.

On Finance.

Samuel V. Merrick, *Chairman,*
Frederick Fraley,
Abraham Miller,
Matthias W. Baldwin,
Henry Troth.

Managers of the Sinking Fund.

Samuel V. Merrick, *Chairman,* Frederick Fraley,
Matthias W. Baldwin.

Auditors.

Isaac B. Garrigues, *Chairman,* William H. Carr,
Ambrose W. Thompson.

(Extracted from the minutes.)

J. Henry Bulkley, *Chairman.*

William Hamilton, *Actuary.*

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1840.
With Remarks and Exemplifications by the Editor.

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1. For a *Self-tending Saw Mill;* Edwin Moody and Samuel Morrill, Andover, Merrimac county, New Hampshire, February 8.

Several patents have been granted for objects similar to that had in

view by the patentees of this mill, namely, to perform all the motions necessary in setting the log, and actuating the other parts of the machine, without labour on the part of the tender, whose only business will be to place a new log on the carriage, and to remove the stuff as it is sawn up. The manner of doing this is, in the present instance, represented in twenty-two figures in the drawings, and the claims are to a number of special arrangements, referred to by letters, and not, therefore, affording, if given alone, any idea of the means by which the design is carried out.

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2. For machinery for *Sawing Stone;* David V. Rannells, Washington, Mason county, Kentucky, February 8.

This machinery is intended for sawing stone either into square, cylindrical, or columnar, blocks. Many machines have been contrived for this purpose, both in ancient and modern time. The patentee is limited, therefore, in his claims to the special arrangements devised by him. These we shall not attempt to describe, for two reasons; first, from the difficulty of doing so, clearly, without the drawings; and secondly, because we do not perceive in this machine any thing that is likely to bring it into extended use, if into use at all, excepting for the purpose of essaying it. We have seen marble sawed cylindrically, but so far as our observation and information extend, machines for this purpose are rarely used, although descriptions of them are to be found in the books, and this would not be the case were they found to save labour.

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3. For *Dressing Mill Stones;* Robert M. Smith, Rutherford county, Tennessee, February 8.

This patent is taken for the particular manner of laying out the furrows, the claim being to "the giving to all the furrows the same draft, as described; and also in giving the furrows a crook, or elbow, at a point about midway between the verge, or periphery, and the eye of the stone, for the purpose, and in the manner, described." Numerous patents have been taken for modes of laying out the faces of mill stones, most of which, undoubtedly, have been indebted for their supposed value to the imaginations of their contrivers, as they have not gone into extended use; such, we apprehend, will be the fate of that before us.

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4. For *Preventing and Checking Fires;* L. Bush, administrator of Isaac Lowell, Pendleton, Niagara county, New York, February 12, not issued until October 16.

The patentee tells us that the nature of his invention "consists in taking water from a cistern, reservoir, well, or from any other source, and conducting it by pipes, over, in, through, and upon, any and every portion or section of a building, internally and externally, in such a way as that in a few minutes the whole surface, externally and internally, may be covered with water, and a constant flow of water be

kept up for any length of time, by receiving the water back into the reservoir, and using it over and over again;" and all this to be effected by a machine which "for buildings of ordinary height may be worked by one man. Two men can work a machine calculated for the highest building."

The foregoing reminds us forcibly of the announcements made by the Marquis of Worcester in his "Century of Inventions," but we are not, in the present instance, as in the case of the Marquis, left to invent the machine over again, as, for our perfect edification, we have it described and represented in drawings. We cannot give the views, or speculations, of the inventor, at any extent, but he tells us that the "*simplicity*" of his machine "is such that the whole expense of one will be trifling, compared with the expense of any machine now in use, designed for the same purpose, and will bring it within the means of almost every person to have one permanently attached to his building." "The inventor claims as new, and as his invention, the arranging of pipes along the roofs of houses, having apertures to admit of the water flowing out upon the roof, for the purpose of extinguishing fires; the water being forced into said pipes by a double acting force pump, as described, or by any other means substantially the same."

The reader who does not perceive the absolute absurdity of the foregoing plan, by which one, or two, men are to deluge a building with water, both internally and externally, has not yet mastered the horn books of mechanics, and hydraulics, and such we cannot take the time to instruct. One of the most amusing parts in the whole matter is the idea of collecting the water that has been once used to extinguish a fire, and of using it over again. The modus is not given.

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5. For improvements in *Buckles, Clasps, Hooks and Eyes, &c.;* William Church, a citizen of the United States, residing in Great Britain, February 18.

"These improvements consist, in the first instance, in the adaptation of a lever to the buckle, as a substitute for a pointed tongue; and in the second instance, in the adaptation of a spring stop to a clasp, catch, or other fastening, for the purpose of retaining the connexion between the two parts when united, or in a holding position." "The improvements in clasps, catches, hooks, or other such fastenings, consist in the adaptation of a spring stop, having a double inclined plane, which, when the two parts of the clasp or other fastening are put together, shall prevent their separation until a force is applied sufficient to push the staple past the inclined part of the spring." The devices proposed to be used are represented in twenty-nine separate figures in the drawings, the claim, however, is a very limited one, being to "the application or substitution of the lever which pinches, or presses, the strap, in place of the ordinary tongues, or points, entering, or piercing, the strap, or bandage, as has been the case heretofore."

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6. For a *Portable Grist Mill;* Isaac Straub, Cincinnati, Ohio, February 18.

"My first improvement consists in the addition of an elastic bridge tree to the ordinary bridge tree, by which the spindle is raised and lowered, which additional bridge tree I usually make of a strip of wrought iron. My second improvement consists in the manner of affixing and running the spindle, said spindle being sustained by a permanent step at its lower end, and by an adjustable quarter bush at its upper end; there not being any bush, or support, between its two extremities."

The claim is to "the additional bridge tree, made of wrought iron, or other elastic material, having on its upper side the step of the spindle, its ends being attached to the base of the frame, and the raising and lowering of it being effected by the ordinary bridge tree, in the manner set forth."

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7. For constructing *Ships, Brigs, &c.;* George F. Bigelow, Norfolk, Virginia, February 18.

The following is the substance of the specification of this patent, that part only being omitted which consists of references to the drawings, and which are not necessary to a clear understanding of the proposed plan.

"Be it known that I have invented an improvement in the manner of contructing ships, brigs, and vessels of all kinds, either for sea or river service, by which improvement they are, whether large or small, built upon an established principle, which, it is believed, will be found in practice to furnish vessels which will pass through the water with less resistance, and to possess greater stability, than those built upon any other plan.

"The principle upon which I proceed and upon which my improvement rests, is that of making all the water lines of my vessel of whatever kind it may be, segments of circles. In carrying out this principle rigidly, the stem and stern, or fore and aft parts of my vessels will have the same form, and the greatest breadth of beam will be exactly amidships. Should it, however, be desired to have the greatest breadth of beam either forward, or abaft, of this point, it may be effected to any desired extent by adopting two different curves in each of the water lines; in which case the shortest end will become a segment of a curve of smaller radius than that of the longer end; the variation of the radius being governed by the distance to which the greatest breadth of beam is removed from midships; a variation which will not, in the slightest degree, affect the principle upon which I proceed, namely, that in passing through the water, the lines by which said water is divided by the forward part of the vessel, and those also by which it flows in towards the stern, shall both, whatever may be the draft of the vessel, be simple segments of circles.

"Although it is not absolutely necessary to the carrying out of my principle of construction, that the stem and stern posts should rise vertically, or nearly so, from the keel, I prefer so to plan them, as by this means a greater degree of strength may be attained, and I am well assured that a vessel so formed, will pass through the water

with equal facility as one under the ordinary construction. This observation applies more particularly to the stem of the vessel, or cutwater, as usually formed.

"Having thus fully described the nature of my invention, and shown the manner in which I carry the same into operation; what I claim as constituting my improvement, and desire to secure to myself by letters patent, is the so constructing of ships, and all other vessels, either for sea or river service, as that all the water lines, from stem to stern, either from midships, or from that part having the greatest breadth of beam, shall consist of segments of circles, as herein set forth."

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8. For a machine for *Cutting Veneers;* William R. Greenleaf, and Alonzo C. Gerry, in the Town of Gerry, Chatauque county, New York, February 18.

The veneers are to be cut in this machine by means of a long stiff knife, fixed obliquely across a sliding gate; and the patentees say, "we are well aware that machines with sliding gates, and knives, for cutting shingles, staves, and other kinds of thin stuff, are in use, but they are not capable of cutting the kind of veneers referred to, in consequence of the knives not being sufficiently stiff, or unyielding; in this respect, we believe, our machine differs very essentially from all others; and also in the construction of the feeding works." The claims are to the method of holding, and adjusting the piece from which the veneer is to be cut, by means of sharp pointed, and blunt screws. The mode of bringing the stuff forward, and the mode of setting the knife by socket set screws.

This machine can be applied to short stuff only, being limited to the convenient length of the knife, which must, of necessity, operate across the grain. It is proposed to steam the wood, and this would, undoubtedly, be necessary in all curley stuff. The general construction of this machine not being new, the claims, it will be seen, are limited to matters of detail, giving but little security, as there would be no difficulty in varying these so as to avoid all interference.

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9. For *Oiling Mill Spindles;* Elijah W. Welsh, Paris, Fauquier county, Virginia, February 18th.

This patent is taken for an improvement on a former patent, dated January 28th, 1840. In the additional specification, we are told that "the oil is admitted through an aperture closed by a screw; or it may be admitted through the collar;" and the claim is to the "mode of oiling the necks and bushes of mill spindles; that is to say, by the described combination of the circular box, hollow stem, and hollow spindle neck, with the square fountain containing the oil and bush."

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10. For *Measuring for Garments;* Daniel Williams, city of New York, February 18th.

This patent is also for an improvement upon the plan for which a

former patent was granted, dated the 26th of April, 1839. The claim made is to "the combination of the graduated slide, and segment, with the instrument originally patented, substantially as the same is described, such combination being intended to indicate the proper position of the upper point of the fore part, shoulder seam."

11. For *Saddles with elastic Seats;* Charles King, Mount Pleasant, Jefferson county, Ohio, February 21.

In this saddle there is a flat plate spring placed behind the cantle, and attached thereto at its middle; its two ends rising to a distance from the cantle. These ends are connected by screw rods and nuts to two girths, which pass along to the fore part of the saddle tree, under the seat; these girths may be tightened by means of the nuts upon the rods, which pass through the cantle for that purpose. The ends of the springs are covered, and hidden, by leather casings behind the cantle, which may be opened when it is desired to regulate the force of the springs. The claim is to "the mode of connecting the springs behind the cantle with the webbing within it, and regulating the tension of the same by means of the ⊥ bolts passing through the cantle and spring, with the nuts on the ends thereof, as set forth." This is a more neat and simple, and, we think, a more effective mode of forming a spring saddle, than most of those which have been previously patented.

12. For a machine for *Punching Iron;* Samuel Davis, Mifflin, Juniata county, Pennsylvania, February 21.

This machine is intended, principally, for punching sheet iron for manufacturing stove pipe. A follower, carrying a series of punches, is brought down by means of a combined lever and cams. The perforated dies upon which they operate, are in separate pieces, and they, and the punches, may be renewed at pleasure. The claim is to the special arrangement of the respective parts, as described, there not being any novelty in the general plan of operating a number of punches at the same time.

13. For a *Lime Kiln;* Isaac Richardson, Paoli, Chester county, Pennsylvania, February 21.

This kiln differs from many others only in the manner of arranging the flues, as indicated in the claim, which is to "the manner of constructing and combining the flues below the ash pit, so as to admit the air at the back as well as at the front and sides, in a lime kiln for burning anthracite on grate bars, by natural draft; governed as set forth, the other parts of the kiln being constructed substantially, as described."

14. For a machine for making "*Wrought Iron Spikes;*" John M'Crone, Ellicott's Mills, Baltimore county, Maryland, February 21.

"The general arrangement of this machine does not differ materially from some others, and I therefore do not claim it as of my invention, but what I do claim, is the gripping of the spike upon the two stationary dies, by the two movable dies, with the arrangement for removing it, when completed, by the action of the finger; constructed, combined, and operating, in the manner set forth. Also the particular arrangement and combination of the heading apparatus, consisting of the lever, working shaft, and slide, operating by a crank on the end of the main shaft, as set forth."

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15. For an improvement in *Weaver's Harness;* John Thorp, and William G. Angell, Providence, Rhode Island, February 26.

This patent is obtained for an improved manner of using the knotted heddle stuff, of which weaver's eye harness is made. The claim is to "the chain of knotted heddle stuff of which weaver's harnesses are intended to be made, as described, also the connecting by knots, or half knots, the two pieces of wire, so as to form eyes suitable to be used in making weaver's eye harness."

The subject is not illustrated by drawings, yet it seems to be a case which "admits of drawings." We must suppose, however, as it has been passed by the office, that the thing patented did not admit of being drawn, and that the description, although to us somewhat obscure, would be clear to a professional weaver.

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16. For an *Endless Chain Bucket Wheel;* John Dutton, Jr., Aston, Delaware county, Pennsylvania, February 26.

This patent is obtained for a proposed improvement on a plan of using an endless chain of buckets, attached to a band, or strap, and passing around two drums, in the manner of flour mill elevators. The improvement, so called, consists in making the front of each bucket double, a space being allowed between the two metallic plates of which it consists; this opening is to operate like a funnel, for the purpose of conducting any water which may spill over from the front edge of any one of the buckets, into that immediately below it. The claim is to "the construction of the spout on the outside of each bucket for preventing a waste of water, by conducting that which runs over the edge of the bucket after it is filled, to the bucket below." This is a claim upon which to obtain a patent, but as the general plan has been found inferior to the employment of an overshot wheel, which it is intended to supersede, we apprehend that the *improvement* will not suffice to bring it into general use; the complexity of this apparatus, and its consequent liability to get out of order, which have condemned it for more than a century, still remaining.

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17. For a machine for *Raising Stumps;* John D. Akin, Columbus, Warren county, Pennsylvania, February 26.

The claim to this machine is limited to "the employment of an eccentric wheel for bringing the machine above, or moving it from, a stump, in a sideway direction; constructed, and operating, as de-

scribed." The general plan of applying power by means of a windlass and chain, is that adopted, and in a way which does not present any thing of a novel character; the eccentric wheel, which is the only thing claimed, does not appear to be a very important feature in the machine, and the purpose for which it is used may be equally well attained without it.

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18. For a *Truss for Hernia;* Moore R. Fletcher, Boston, Massachusetts, February 26.

The plan of adapting the pad to the ruptured part, which is the main subject of this patent, does not differ materially from the manner of adjusting truss pads, to the particular case of the wearer, which has been before employed; but the difference has been deemed sufficient to justify its being made the subject of a patent, the claim under which is to "the attaching of the pad spring to a wheel, as described, and by this means rendering the pad movable, so that it can be placed in any required position. Also the mode of varying the amount of pressure on the pad, by means of the screw passing through the rivet and pressing against the pad spring. Also the combination of the spring rider with the wheel and pad spring, and their further combination with the truss spring. The whole being constructed, and operating, as set forth."

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19. For an *Excavating Machine;* Joseph Hanchett, Coldwater, Branch county, Michigan, February 28.

"The nature of this invention consists in combining together a common wagon, with a rising and falling frame containing ploughs for loosening the earth, and turning the same into the buckets of a revolving vertical wheel placed behind the forward plough, and at the side of another plough; which wheel elevates the earth and deposites it at the side of the excavation, or into a box or receiver on said wagon, or into a cart. Also in shaping the side of the ditch by trail cutters behind; the whole being drawn forward by animal power." The claim is to "the before described combination and arrangement of the elevating wheel, ploughs, adjustable frame, and inclined trail cutters, for excavating and cutting ditches."

This plan will, we are convinced, add another to the many abortive attempts which have been made to construct excavating machines for ditching and embanking, or for loading the excavated earth into carts, or other vehicles. We are aware that there are in operation some very useful machines for excavating, but we do not know of any completely successful effort to accomplish the purposes proposed by that before us. The object is one of great importance, particularly in the prairie regions, and there are several individuals now at work seeking to obviate the objections to the machines heretofore essayed. We think that they are, in general, aiming at more than they will be able to effect, but doubt not that some valuable improvement will be made in this department of engineering.

Specifications of English Patents.

ification of a patent granted to Rice Harris, *of Birmingham, r certain improvements in Cylinders, Plates and Blocks, used Printing and Embossing.* [Enrolled, Nov. 12, 1840.]

his patent is,—1st, for the manufacture of cylinders, plates, and ks, made of, or coated with glass, enamel, or other vitrified sub-:es, containing silica, boracic acid, or either of them, sufficient to er such cylinders, &c., capable of being acted upon by hydroflu-acid, alone or in combination with ammonia, or other base. The iders thus produced, being used for printing or embossing of linen, llen, silk, or other similar fabrics. 2nd, the application of tubes nings for cylinders made of copper, brass, or other expensive ma-ls, for the purpose of economising those metals. The glass cylin-, &c., are made in the following manner; twenty-eight parts (by ght) of clean Isle of Wight sand; thirty-five parts of red lead; teen of soda ash; seven of nitrate of soda; seven of calcined iron es; seven of refined borax; seven of calcined copper; seven of le of manganese; and twenty parts of pulverized flint glass, are ted together in a large crucible or pot, in a glass furnace. When e ingredients have become fused, and the whole, or nearly the ›le, of the volatile gas has been disengaged, the fluid mass is trans-ed to smaller pots for the convenience of casting. A cast-iron ıld, in parts, is provided, its internal diameter being that of the nder required, and furnished with an inner core or tube, through ch a current of cold water is continually flowing to prevent the on of the tube. When the melted glass is poured into the mould, lid cylindrical piston is forced down upon it by a strong vertical w, in order to compress and solidify the mass. The cylinder thus ned, is to be annealed in a kiln of the usual kind, by being placed . case of iron rather larger than the cylinder itself, and surrounded ı finely-powdered charcoal; this case is to be suspended within kiln, so that the cylinder may be uniformly annealed all over. the cylinder may be annealed in the mould in which it was cast. : cylinder is then to be smoothed and polished in the manner ally adopted in glass polishing.

ylinders, plates, &c., may also be made of other materials, and ted externally with some suitable vitrified substance, capable of ıg acted upon in like manner by the acid. The cylinder, &c., pro-ed in either of these modes, may be engraved upon the surface in usual way of engraving glass, or may be etched by treatment h the acid; in the latter case, the parts not to be acted upon are tected by wax or other suitable etching grounds, and the cylinder nersed in hydro-fluoric acid; by this means the pattern, in relief printing, or sunk if for embossing, is produced upon the surface. l the cylinder being mounted on a mandril or axis, is ready for . In the formation of metal cylinders upon the plan here patent-tubes or linings of iron, or compressed wood, are put into cylin-

scribed." The general plan of applying power by means of a lass and chain, is that adopted, and in a way which doe: present any thing of a novel character; the eccentric wheel, wh the only thing claimed, does not appear to be a very important fe in the machine, and the purpose for which it is used may be eq well attained without it.

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Specification of a patent granted to Rice Harris, *of Birmingham, for certain improvements in Cylinders, Plates and Blocks, used in Printing and Embossing.* [Enrolled, Nov. 12, 1840.]

This patent is,—1st, for the manufacture of cylinders, plates, and blocks, made of, or coated with glass, enamel, or other vitrified substances, containing silica, boracic acid, or either of them, sufficient to render such cylinders, &c., capable of being acted upon by hydrofluoric acid, alone or in combination with ammonia, or other base. The cylinders thus produced, being used for printing or embossing of linen, woollen, silk, or other similar fabrics. 2nd, the application of tubes or linings for cylinders made of copper, brass, or other expensive materials, for the purpose of economising those metals. The glass cylinders, &c., are made in the following manner; twenty-eight parts (by weight) of clean Isle of Wight sand; thirty-five parts of red lead; fourteen of soda ash; seven of nitrate of soda; seven of calcined iron scales; seven of refined borax; seven of calcined copper; seven of oxide of manganese; and twenty parts of pulverized flint glass, are melted together in a large crucible or pot, in a glass furnace. When these ingredients have become fused, and the whole, or nearly the whole, of the volatile gas has been disengaged, the fluid mass is transferred to smaller pots for the convenience of casting. A cast-iron mould, in parts, is provided, its internal diameter being that of the cylinder required, and furnished with an inner core or tube, through which a current of cold water is continually flowing to prevent the fusion of the tube. When the melted glass is poured into the mould, a solid cylindrical piston is forced down upon it by a strong vertical screw, in order to compress and solidify the mass. The cylinder thus formed, is to be annealed in a kiln of the usual kind, by being placed in a case of iron rather larger than the cylinder itself, and surrounded with finely-powdered charcoal; this case is to be suspended within the kiln, so that the cylinder may be uniformly annealed all over. Or, the cylinder may be annealed in the mould in which it was cast. The cylinder is then to be smoothed and polished in the manner usually adopted in glass polishing.

Cylinders, plates, &c., may also be made of other materials, and coated externally with some suitable vitrified substance, capable of being acted upon in like manner by the acid. The cylinder, &c., produced in either of these modes, may be engraved upon the surface in the usual way of engraving glass, or may be etched by treatment with the acid; in the latter case, the parts not to be acted upon are protected by wax or other suitable etching grounds, and the cylinder immersed in hydro-fluoric acid; by this means the pattern, in relief for printing, or sunk if for embossing, is produced upon the surface, and the cylinder being mounted on a mandril or axis, is ready for use. In the formation of metal cylinders upon the plan here patented, tubes or linings of iron, or compressed wood, are put into cylin-

ders of brass, copper, or other suitable metals, thereby reducing the quantity of the more expensive materials. The external brass or copper cylinder has a lining cemented throughout its length, furnished at each end with a screw projecting beyond the cylinder for receiving two caps or nuts, which attach it securely to the cylinder. A rib or feather upon the lining tube fits into a corresponding groove upon the axis or mandril, in the usual way of mounting printing cylinders.

Mech. Mag., Nov., 1840.

Specification of a patent granted to Henry Montague Grover, *of Boveney, Buckingham, for an improved method of retarding and stopping Railway Trains.* [Enrolled, Nov. 2, 1840.]

The "method" here patented, if not an improved, is at least an abundantly "singular" one. From the lower frame of the carriage or truck, a wooden block or box is suspended by a bar link, within about half an inch, more or less, of the wheel; this box contains a large soft iron horse-shoe, enveloped with wire helices for converting into a powerful electro-magnet when its good offices are required. From these helices, wires proceed up into the carriage where a galvanic battery is situated, and with which they can be connected at pleasure. Should any accident or other circumstance render it expedient to retard or stop the train, connecting the wires with the battery converts the horse-shoe into a powerful magnet, which, hanging within a "striking distance," catches hold of the rim of the iron wheel, pressing itself and the wooden box against it, after the manner of the brakes usually employed. The patentee states that these electro-magnetic brakes may be applied to one or more of the wheels of a train, or the apparatus may be applied to one wheel, and its action transmitted to other wheels by means of levers. We apprehend Mr. Green has greatly underrated the extent of power required to arrest the progress of railway trains, and the electro-magnetic power capable of being obtained by the means he proposes. Ibid.

Specification of a patent granted to Thomas Gadd Matthews, *and* Robert Leonard, *of Bristol, for certain improvements in machinery or apparatus for Sawing, Rasping, or dividing Dye Woods or Tanners' Bark.* [Enrolled, Nov. 5, 1840.]

These improvements consist in certain arrangements of circular saws, by means of which, woods, or bark, are reduced to a finely divided state for the use of dyers and tanners, in a more economical and expeditious manner than has heretofore been effected. The peculiar feature of this invention is, combining a number of circular saws upon a rotary spindle in such a manner that although not in actual contact, they are placed so nearly contiguous to each other, that when a piece of wood, or a quantity of bark is brought under their operation, it will be sawn, rasped, or reduced to a finely divided state without leaving any veneer. The circular saws are mounted

on their spindle, and the space between each saw is filled up with pieces of wood, felt, metal, pasteboard, or other suitable substance; the saws are then secured between two cheeks by nuts and screws. The log of wood is placed upon an inclined plane, and made to slide down towards the saw by a pushing apparatus, consisting of a worm wheel, rack and pinion, driven by suitable gearing connected with the prime mover of the machine. A counterbalance weight is attached to the rack by a cord passing over a pulley, to facilitate its ascent up the inclined plane, for the introduction of a fresh log of wood. The claim is to the application of rotary circular saws to the sawing, rasping, or reducing to powder, of woods or bark, for the use of dyers or tanners in whatever manner the same may be applied.

Ibid.

Specification of a patent granted to William Peirce, *of James's Place, Hoxton, for improvements in the construction of Locks and Keys.* [Enrolied, Nov. 2, 1840.]

These locks, which are upon Barron's principle, with numerous tumblers, are furnished with a detector, consisting of a sliding bolt acted upon by any one or all of the tumblers; the opposite end of this sliding bolt is jointed to a small lever, mounted on a suitable axis. Within a tube, opposite the lower part of the key-hole, a dart, or sharp-edged punch is placed upon a strong spiral spring; there is a notch on the under side of the dart, in which the detector lever rests and holds the dart down upon the compressed spring. On attempting to open the lock with any but the original key, one or other of the tumblers is over lifted, which, acting on the detector lever, releases the dart or punch which flies out through the key-hole, wounding the hand that holds the key. The face of the punch being in the form of a letter or figure, inflicts a wound that for several weeks identifies the aggressor; these locks have therefore been termed *Identifying Detector Locks.*

In order to prevent the accumulation of dirt, &c., within the pipe of the key, a metal stop is fitted so as to work freely within it, being kept flush with the end of the pipe by means of an internal spiral spring, which yields to the pin of the lock when in use.

The claim is,—1st. The mode of constructing detecting locks. 2nd. The mode of applying spring stops to keys.

Ibid.

Progress of Practical & Theoretical Mechanics & Chemistry.

Observations on Coal, the duration of its supply, and on its reproductive Power. By Dr. Wilkinson, *Bath.*

During the debates on the Budget for 1838, Sir R. Peel remarked on the proposed reduction of duty on coal, in order to promote its exportation, that he was not satisfied of the abundant supply of coal

in this country. He knew that the reproductive power of coal was not so rapid as the consumption, whatever chemical combinations it might possess. Any observations made by this distinguished statesman are entitled to the most respectful attention. I presume, the most satisfactory reply will be by an inquiry into the formation of coal, from which may be deduced the degree of apprehension as to the duration of its supply; and whether any such apprehension may be diminished by any supposed reproductive power.

In some "Observations" I lately published on the green mineral naptha of Barbadoes, I introduced some new opinions relative to coal. These opinions have led to correspondences with many of my philosophical friends; and the result has been, that probably coal does not originate from vegetable matter. In those extensive masses of vegetables discovered at considerable depths below the earth's surface, or the beds of the ocean with its sub-marine forests, elevated by the agency of volcanic power above its water level, the wood assumes different characters, according to the conditions to which it may be subsequently subjected. In the vicinity of Bath, I have seen, under the blue lias, the same mass of wood undergoing different changes; that part which had not been under much pressure retaining its ligneous character—the next portion resembling the surturbrand of Iceland, or the Bovey coal of Devonshire—and the extreme part had exactly the character of jet, admitting of such a beautiful polish, that the present ingenious engineer to the Kennet and Avon Canal Company (Mr. Eastwick) made from it a series of primitive crystals. In the heath where Bovey coal is found, are numerous stumps and roots of trees, so that the coal appears to be the broken trunks and branches, which, by slow and gradual change from the vegetable character, are converted to that of jet or asphaltum. These changes appear to have resulted from the combined effects of water and pressure, without any agency of heat, the bituminous matter being retained; vegetable matter exposed to the action of water alone, undergoes a gradual change, blackens, and assumes a charred appearance. It is by such a process, the roots and stalks of vegetables, on heaths and morasses, are converted into turf; when deeper in the earth, then a slight pressure operates, that the roots and fibres become less distinct, the vegetable is resolved into a black extractive substance, and called peat; and when extensive masses are immerged at greater depths, then surturbrand, Bovey coal, &c., are formed. All these substances, when analyzed, yield those results which correspond to the elementary constituent parts of vegetables.

With respect to coal, the formations are so distinct, that they are always found in the same relative geological situation. It is found in a basin reposing on limestone, and never observed either on primitive or transition rocks, and in the analysis yields very different results; frequently are observed vegetable impressions in the schist above coal, yet no geologist has inferred from this appearance that the substance originates from the same organic source. In those extensive analyses which are daily conducted on a large scale at gas establishments, five elementary principles are invariably found—viz.,

oxygen, hydrogen, carbon, nitrogen, and sulphur; and, with the carboniferous limestone, millstone grit, and old red sandstone, constitute a series of associated rock formations, and with regular alternations. This is not the case with turf, peat, Bovey coal, &c. They are invariably found to result from binary or ternary arrangements of the three elementary principles—viz., oxygen, hydrogen, and carbon—and which we invariably find resulting from the destructive distillation of wood. In no instance are found in these substances either nitrogen or sulphur, nor are they observed to have any regular geological position. Turf and peat are found on the granite beds of Greenland and Iceland, and on the tertiary beds of France and England. Hericart de Thury describes some of these deposits in Dauphiny at 7000 feet above the level of the sea. The celebrated botanist, De Candolle, observed, that in Holland the turf is the result of sea weeds, and, in elevated districts, principally from the leaves of trees. Most of these are of recent formation; wood which has been worked, and tools of iron, have been found in the turtiary.

It must be admitted, that in coal-fields are observed representations of the trunks and stems of arundinaceous plants, also some participating of the palmaceous and of coniferous plants; and my late learned friend, Steinhauer, supposed he had discovered tubular acini or leaves in some of the calamites and portions of the phitolithus notatus. In these I have never observed any satisfactory ligneous characters, nor is it easy to conceive that, in such extensive imaginary woody masses, the vegetable part should be so effectually removed, and in lieu thereof earthy materials substituted, excepting a very thin tunic of carbonized matter, which certainly increases the difficulty attending the hypothesis of the whole mass being a cast corresponding in size to the supposed vegetable. When coal appears in the vicinity of rocks of igneous origin, as the Rowley rag, basalt, &c., its bituminous portion is volatilized, and it exists in a coke-like form; so also, when not reposing on its limestone bed, but on the lower red sandstone, it equally loses its principle of inflammation, and constitutes stone coal or culm, as seen in Wales.

Contemplating coal as a distinct rock formation, formed under certain conditions of the earth long anterior to man, we have no more reason for supposing any reproductive power, than that those portions of St. Vincent's Rocks which have been detached may be again restored. Thus, considering coal as not a vegetable product, or consisting of such principles as not to admit of any supposed power of reproduction, have we any reason to apprehend a serious exhaustion of this valuable material?

Let us take into our calculation the extensive coal-fields of Northumberland and Durham, Yorkshire, Warwickshire, Lancashire, Shropshire, Staffordshire, Cumberland, Somersetshire, Gloucestershire, and the counties of Nottingham and Derby, and, when to these we add the great supply afforded by Scotland, North and South Wales, we need be under no apprehension that, however great our consumption, still our supply is not only adequate to every purpose, but also

would justify Government in promoting exportation by every effort in their power.

Min. Review, December, 1840.

On the Manufacture of Flint Glass. By APSLEY PELLATE, A. C. E.

Flint glass, called by the French "crystal," from its resemblance to real crystal, is composed of silex (whence the English name,) to which is added carbonate of potash and litharge, or red lead; to which latter material is owing, not only its great specific gravity, but its superior lustre, its ductility, and power of refraction.

It is necessary for optical purposes that flint glass should be perfectly free from striæ, otherwise the rays of light passing through it diverge and become distorted, and this defect is caused by the want of homogenity in the melted mass, occasioned by the difficulty of perfectly fusing substances of such different density as the materials employed. The materials being properly prepared, are thrown at intervals into a crucible of Stourbridge clay, which will hold about 1600 lbs. weight of glass when fused. The mouth of the crucible is then covered with a double stopper, but not luted, to permit the escape of the moistute remaining in the materials, as well as the carbonic acid gas and excess of oxygen. It requires from fifty to sixty hours application of a rapid, intense, and equal heat to effect the perfect fusion of the materials, and to drive off the gas; during which time the unfused particles and excess of salts are skimmed off as they rise to the surface. The progress of fusion cannot be watched, nor can any mechanical means for blending the materials during fusion be resorted to, lest the intensity of the heat requisite for the production of a perfectly homogeneous glass should be diminished, the quality of the product being influenced by any inattention on the part of the fireman, as well as by the state of the atmosphere, or of the wind. It has been ascertained, that there is a certain point, or crisis, of fusion at which the melted metal must be kept to insure a glass fit for optical purposes, and even when that point be attained, and the crucible shall furnish proper glass during several hours, should there be such diminution of heat as to require the furnace to be closed, the remainder of the metal in the crucible becomes curdy and full of striæ, and thus unfit for use. It is the same with the glass made for the flat bore tubes for thermometers, which are never annealed, because the smoke of the annealing furnace would render the interior of the bore unfit for the reception of the mercury. These tubes will only bear the heat of the blow pipe when they are made from a metal which has been produced under all the favourable circumstances before described. It is, therefore, to be inferred, that the most homogeneous and perfect flint glass can only be produced by exposure to an intense and equable degree of heat, and that any excess or diminution of that heat is injurious to its quality.

Flint Plate.—The English method of manufacturing the flint plate for optical purposes is thus described. About seven pounds weight of the metal is taken in a ladle of a conical shape from the pot at the

proper point of fusion, and then blown into a hollow cylinder, cut open, and flattened into a sheet of glass of about fourteen inches by twenty, and varying in thickness from three-eighths to one-fourth of an inch. This plate is afterwards annealed, and in this state goes into the hands of the optician, who cuts and grinds it into the requisite form. When a glass furnace is about to be put out, whole pots of metal are sometimes suffered to remain in it, and cool gradually. The crucibles being destroyed, pieces of glass may be cloven from the mass of metal, softened by heat, and made to assume the requisite form, and then ground. It is believed that the excellent glasses made by Frauenhoffer, and other manufacturers on the continent, are produced by some such means. On attempting to cut glass ware, it is easily perceived if it be sufficiently annealed; if not, the ware is put into tepid water, which is heated, and kept at the boiling point during several hours; it is then suffered to become gradually cold. This method is more efficacious than re-annealing by the ordinary means. A piece of unannealed barometer tube of forty inches in length being heated and quickly cooled, contracted only one-sixteenth of an inch, whereas a similar piece, annealed by the usual means, contracted nearly one-eighth of an inch. Unannealed flint glass, being heated and suddenly cooled in water, exhibits the appearance of a mass of crystals; it is thence inferred that the process of annealing renders the glass more compact and solid; it thus becomes incapable of polarization.

Railway Mag., December, 1840.

New Air Engine.

Both in England and France many unsuccessful attempts have been made to convert air into a motive power—Sir George Cayley has at length succeeded. The public will have an opportunity of judging for themselves of the value of this discovery, as soon as a locomotive carriage, now in progress of manufacture, can be got ready. The principle of the new engine is easily explained—the details we reserve for another occasion. Air is compressed by the pump into a receiver, to be used when wanted. Motion is communicated to the wheels by pistons acted upon by the air, which is rarefied by heat in its passage from the receiver to the cylinders, where it acts upon the piston rod much in the same way that steam does. Thus, to communicate motion to the piston, a portion of the air in the receiver is forced by compression into tubes subjected to heat, and from thence, in its rarefied state, it rushes to the cylinders as the only place of escape. Motion is accordingly produced. An experimental engine, upon this plan, was exhibited last year to Messrs. Babbage, Rennie, Gordon, Bramah, Renton, and others. It worked with great steadiness at rather above five horse power. The power, which was under perfect control, was capable of immediate increase or decrease, the expense of fuel following exactly the same ratio as the power, which is one of the peculiarities of this engine. If it were stopped for a minute, or any number of minutes, or for half an hour, no loss of fuel took place—that is

to say, no loss takes place while the engine stands idle. No water is required—a serious consideration; and the consumption of coke is only from four to five pounds weight per horse power per mile.

This experimental engine, though perfect as to power, was found inconvenient, in consequence of some of the dust from the coke getting into the working cylinders, which caused them to require more lubrication than was convenient for practical purposes. The engine now building is constructed upon a plan to do away with this evil, which appears to be the only remaining impediment to be overcome. The air engine, by obviating the necessity of carrying water, and by obtaining the full power from combustion in the most economical manner, bids fair to be applicable on many occasions where the steam engine is inconvenient, and to vie with it in power. We are extremely anxious to see the new machine at work.

Mining Journal, December, 1840.

Progress of Civil Engineering.

Experiments with Locomotive Engines, on the Hull and Selby Railway.

On Tuesday, the 10th instant, a course of five days' experiments commenced with the engines of the above railway, originating through the following circumstances:—

About the commencement of the present year, six engines somewhat similar to those on the Leeds and Selby line, were in greater or less state of forwardness for the Hull and Selby Railway, at the works of Messrs. Fenton, Murry, and Jackson, of this town, when the Hull and Selby Railway Company resolved to have six other engines, on the most approved construction which experience up to that period could produce, from the previous working of locomotives on the various railways. Four objects were particularly kept in view, namely, *safety*, *simplicity*, *accessibility* of the various parts, and *economy*, the whole combining general *efficacy* and *durability* of the engine throughout.

The first object is secured by giving a more extented *base* for the action of the springs in supporting the weight of the engine, being about six and a half by eleven feet, whereby a remarkably steady motion is secured at thirty miles per hour. It is not at all a matter of surprise that the four wheeled engines of several railways now in use should now and then go off the road, and in an instant, when it is recollected the extreme base of their springs for supporting the engine is only about three and three-quarters by about six feet; hence their rocking, serpentine, and pitching motion, which without any other cause than a slight increase of speed, literally lifts the flanches of the wheels above the surface of the rails, and in three or four seconds the engine is turned end for end, upset in the act, and the train with it; whilst the stability of the engine is effectually secured through an extended base upon the front and hind wheels. By means of a new

combination the best properties of the four-wheeled engines are also completely applied, by resting the weight on the crank-shaft immediately within the wheels, which experience has for years proved to be the least likely to injure it, and thereby avoiding the alarming accidents which have so often taken place by the breaking of the shaft, through placing the weight on bearings outside of the wheels; the centre of the engine being a sort of neutral axis, there is very little power over its motion in that part, and this advantage, by placing the weight on the crank inside the wheels, is in consequence got without a sacrifice of stability.

2ndly. In addition to the safety and simplicity of having only *two* inner frames, instead of three or four, with as many bearings on the crank shaft, the space under the boiler is still further stripped of machinery by a new valve motion, which gives a high degree of openness and facility of access so desirable in examination, cleaning, &c., of the working parts.

3rdly. The steam being used expansively by the valve motion above alluded to, a great saving in fuel is effected, as will be seen on examining the results of the experiments; and as the excessive wear and tear of locomotive boilers arise from intense heat, it is not improbable this decided step towards removing the cause will prevent the effect, namely, the rapid destruction of the boiler. The action of this valve motion is perfectly smooth, being worked by eccentrics (which are also of an improved construction,) and any quantity of steam from 25 to 90 per cent. on the stroke can be admitted into the cylinders with the most ready and complete control, at any speed the engine may be going; if a high wind, or an incline, opposes the progress of the engine, a greater quantity of steam is admitted; if wind or gradients be favourable, the steam is still admitted at full pressure into the cylinders, but shut off at an earlier period, propelling the pistons the remainder of the stroke by its elastic force, similar to driving a timepiece by the uncoiling of the main-spring.

Lastly. A combination of dimensions and proportions have been gleaned from the best results of locomotive engines of various constructions, and in use in different parts of the country. The driving wheels are six feet diameter, length of the stroke two feet, diameter of cylinders twelve inches, inside dimensions of fire box three by three and a half feet, tubes ninety-four in number by nine and a half feet long and two inches diameter. The general diminution of machinery in the construction has given room for ample dimensions in the principal working parts, and thus the whole arrangement has a close bearing on *safety, simplicity, accessibility, and economy.*

Circumstances led to those engines being ordered of Messrs. Shepherd and Todd, Railway Foundry, of this town. The Hull and Selby line was opened with the engines of the former order, but the public and the Company being so much annoyed by hot cinders from their chimneys, burning whatever they lighted upon, and rapidly destroying the smoke-boxes themselves, three of those engines were altered, and succeeded to a considerable extent in diminishing the nuisance, whilst the engines performed better and with less fuel. That fact,

however, being questioned, and two engines of the *improved* construction having got to work, Mr. John Gray, the engineer of the locomotive department, and patentee of the improved engines, urgently requested a most rigorous and simultaneous trial of the different engines, and to be witnessed for the parties concerned by persons above suspicion. Mr. J. Miller and Mr. T. Lindsley represented Messrs. Fenton, Murray, and Jackson; Mr. J. Craven and Mr. J. Barrons represented Messrs. Shepherd and Todd; and Messrs. E. Fletcher, W. B. Bray, J. G. Lynde, jun., J. Farnell, and J. Gray, were the representatives of the Hull and Selby Railway Company. The arrangements for the experiments were, that the gross load should include engine, tender, carriages, and everything in the train.

The steam was got up in the respective engines to the pressure of from fifty-six to sixty-six pounds per square inch; the fires filled to a certain level at the starting in the morning, and filled to the same level on finishing the last trip at night. The pressure of steam at starting was generally up to sixty-six pounds, and was at about half that pressure at the end of each trip. There were *fifty* experimental trips made in all, namely, twenty-four trips with the *Collingwood, Andrew Marvel,* and *Wellington,* the unaltered engines of Messrs. Fenton, Murray, and Jackson. Their average gross load was 53.4 tons, or 1,656 tons, over one mile: consumption of coke 1,013 lbs., or 0.611 lbs. per ton per mile; water 6,500 lbs., or 3.90 lbs. per ton per mile. There were ten trips made with the other three engines of Messrs. Fenton, Murray, and Jackson, which were altered at Hull, namely, the *Exley, Kingston,* and *Selby.* Their average load was 49.16 tons, or 1,524 tons over one mile; consumption of coke 635 lbs., or 0.416 lbs. per ton per mile; water 4,264 lbs., or 2.79 lbs. per ton per mile.

The *patent* engines made by Messrs. Shephard and Todd, viz. the *Star* and *Vesta,* made sixteen trips, and their average loads, &c., were 55.4 tons, or 1.718 tons over one mile; coke consumed, 465 lbs., or 0.271 lbs. per ton per mile; water 2,874 gals., or 1.62 lbs. per ton per mile. The average gross load of all the fifty trips is 53.2 tons, or 1,649.4 tons over one mile, and taking that as a standard load, the consumption of fuel and water performing exactly equal quantities of work, is represented in the following table:

Class of engines.	Load in tons conveyed over one mile.	Elsecar coke used per trip of 31 miles in lbs.	Coke used per mile in lbs.	Coke used per ton per mile in lbs.	Water used per trip of 31 miles in lbs.	Water per mile in lbs.	Water per ton per mile in lbs.
Patent . .	1649.4	446.98	14.41	0.271	2672	86.19	1.62
Altered . .	1649.4	686.15	22.13	0.416	4601.8	148.43	2.79
Unaltered .	1649.4	1007.78	32.59	0.611	6432.6	207.5	3.90

The financial annual result of the three classes of engines for coke

and boilers, with such a traffic as that of the Hull and Selby line, will be about—

4,500*l.* for the unaltered engines,
3,250*l.* for the altered do.; and about
2,000*l.* for the patent engines.

In conclusion, it is deserving of remark, that *all* the attesting witnesses expressed themselves highly satisfied with the manner in which the experiments had been conducted, and with the facilities which the Company so readily granted to enable them to come at correct results. Probably no experiments were ever made under similar circumstances where the parties concerned displayed greater independence, impartiality, and good feeling, than on the present occasion.—*Leeds Mercury.* Mech. Mag., November, 1840.

An Account of the actual State of the Works at the Thames Tunnel (June 23, 1840.) *By* M. I. Brunel, M. Inst. C. E.

In consequence of local opposition, the works have not advanced much since the month of March, 1840; but, as that has been overcome, and facilities granted by the city, the works will be speedily resumed, and the shaft on the north bank commenced.

The progress of the Tunnel in the last year has been, within one foot, equal to that made in the three preceding years. During those periods collectively, the extent of the Tunnel excavated was 250 feet 6 inches, and during the last year the excavation has been 249 feet 6 inches. This progress has been made in spite of the difficulties caused by the frequent depressions of the bed of the river. These have been so extensive that in the course of twenty-eight lineal feet of Tunnel, the quantity of ground thrown upon the bed of the river, to make up for the displacement, in the deepest part of the stream, has been *ten times* that of the excavation, although the space of the excavation itself is completely replaced by the brick structure. On one occasion the ground subsided, in the course of a few minutes, to the extent of thirteen feet in depth over an area of thirty feet in diameter, without causing any increased influx of water to the works of the Tunnel. The results now recorded confirm Mr. Brunel in his opinion of the efficiency of his original plan, which is "to press equally against the ground all over the area of the face, whatever may be the nature of the ground through which the excavation is being carried." The sides and top are naturally protected; but the face depends wholly for support upon the poling boards and screws. The displacement of one board by the pressure of the ground might be attended with disasterous consequences; no deviation, therefore, from the safe plan should be permitted.

The paper is accompanied by a plan, showing the progress made at different periods. It is stated that a full and complete record of all the occurrences which have taken place during the progress has been kept, so as to supply information to enable others to avert many of the difficulties encountered by Mr. Brunel in this bold yet successful undertaking. Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, MAY, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
3	6	12	Im. 75 Virginis,	6	16°	330°
3	7	1	Em.		275	234
7	16	26	Im. *y* Ophiuchi,	6	60	86
7	17	32	Em.		315	352
10	16	17	Im. 351 Sagittarii,	6	133	129
10	17	42	Em.		278	293
23	7	43	Im. *m* Geminorum,	6	79	136
23	8	37	Em.		232	286
25	9	28	Im. 82 Cancri,	6	79	132
25	10	20	Em.		220	273
25	9	33	Im. π^2 Cancri,	6	94	147
25	10	20	Em.		210	280

Meteorological Observations for February, 1841.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction	Force.		
				Inch's	Inch's			Inches.	
	1	32	30	29.80	29.60	E.	Moderate.	.67	Cloudy—rain and sleet.
	2	29	36	.70	.75	W.N.W.	do.		Partially cloudy—par. cloudy.
	3	34	38	.60	.50	W.	do.		Partially cloudy—par. cloudy.
	4	24	32	30.14	30.15	W.	do.		Clear—clear.
☺	5	22	38	.03	29.92	N.E.	Calm.		Clear—clear.
	6	31	43	29.84	.85	N.E.N.	do.		Lightly cloudy—cloudy.
	7	33	32	.88	.94	N.	Moderate.		Partially cloudy—snow.
	8	24	35	30.14	30.18	W.	Calm.		Clear—partially cloudy.
	9	30	33	.00	29.83	N.E.	do.	.30	Cloudy—snow.
	10	19	31	29.73	.72	N.	do.		Clear—flurry of snow—clear.
	11	8	16	.89	.84	W.	Moderate.		Clear—clear.
	12	3	12	.88	.84	W.	do.		Clear—flying clouds.
☽	13	7	17	.79	.78	W.	Brisk.		Clear—clear.
	14	13	27	.77	.77	W.	Moderate.		Fleecy clouds—hazy.
	15	13	22	.72	81	N.W.	blustering.		Clear—hazy.
	16	16	33	.90	.85	W.	Moderate.		Clear—do
	17	27	37	.60	.60	E.	do.	.	Cloudy—lightly cloudy.
	18	24	31	.95	.98	N.	do.		Cloudy—cloudy.
	19	28	37	.60	.55	W.	do.		Clear—cloudy.
	20	23	39	.70	.63	W.	blustering.		Clear—clear.
⊗	21	29	50	.50	.49	W.	Moderate.		Clear—cloudy.
	22	24	44	.50	.50	S.W.	do.		Cloudy—hazy.
	23	35	45	.35	.35	E.W.	Brisk.		Clear—cloudy.
	24	21	25	30.05	30.05	W.	Moderate.		Cloudy—snow.
	25	18	33	.10	.10	E.	do.		Clear—lightly cloudy.
	26	32	47	.00	.10	W.	do.		Cloudy—clear.
	27	40	41	29.60	2 60	E	do.	.15	Cloudy—rain.
☾	28	32	50	.85	.86	S.W.	do.		Clear—clear.
	Mean	23 97	34.07	29.81	29.79			1.12	

	Thermometer.		Barometer.	
Maximum height during the month,	50 00	on the 21st and 28th.	30.18	on the 8th.
Minimum " "	3 00	on the 12th.	[29.35	" 23rd.
Mean	29.02		29.80	

ome[...]						Hygrometer.					
Maximum.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
30.3	⅓	8	1	.	3⅓	....	.	....	....	.	1289
30.3	⅔	14	⅓	.	⅔	....	.	.....	....	.	1277
30.3	.	9⅓	.	.	5	....	.	....	....	.	1238
28.3	⅔	8⅓	.	.	.	....	.	.....	....	.	1233
29.6	⅔	2	⅓	8⅓	.	....	.	.....	....	.	1279
30.1	.	19⅓	.	.	.	....	.	......	....	.	1240
30.6	.	8	.	.	.	....	.	......	....	.	1312
29.8	1	5	4⅔	.	1⅔	55.11	3	.....	61.72	3	1245
30.	.	10⅔	.	.	3⅔	....	.	......	....	.	1217
29.	⅓	5⅓	.	2⅓	⅓	....	.	.....	62.48	1	1243
29.	.	4⅔	.	14⅓	4	....	.	.....	....	.	1231
29.	⅓	5	⅓	5	⅓	....	.	.....	....	.	1280
29	.	.	.	.	2	....	.	.....	....	.	1235
29	.	3	⅓	3⅓	13⅔	....	.	.....	....	.	1236
28	.	3	.	.	5½	....	.	.....	64.07	2	1234
28⅔	⅓	7⅔	⅔	3	2⅓	....	.	.....	....	.	1237
29⅔	8	6	1	.	1	....	.	.. .	....	.	1242
28⅓	1⅓	2	.	11⅔	1⅓	....	.	.....	....	.	1246
29	.	3⅓	.	11⅔	.	....	.	...	....	.	1304
29	.	2⅔	⅔	13⅓	6	....	.	....	....	.	1230
29	.	19⅓	.	.	1	....	.	.....	....	.	1232
⅔ 29	.	7	.	6⅓	.	....	.	.....	....	.	1271
29⅓	⅓	1⅓	.	11	6	....	.	......	....	.	1244
29	⅔	9	⅓	5⅔	1⅓	....	.	......	....	.	1376
29	.	3	.	.	.	....	.	.....	....	.	1239
⅓ 2	⅓	8⅔	.	2⅓	3	....	.	.....	....	.	1241

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

SEPTEMBER, 1840.

No.	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.
1	Philadelphia, .	Philadelphia, .	J. M. Hamilton, .	61.52	66.80	59.46	79.00	49.00	62.53	1⅓	40.00	57.47	1
2	Montgomery, .												
3	Bucks, .	Newtown, .	L. H. Parsons, .	56.80	68.50	54.08	80.50	32.00	59.79	⅓	32.00	46.23	.
4	Lehigh,												
5	Northampton,	Easton, .	Charles Elliot, .	55.43	68.39	59.10	76.00	45.00	60.97	1⅓	....	....	.
6	Monroe	Stroudsburg, .	A. M. Stokes, .										
7	Pike, .	Milford,	Ralph Bull,										
8	Wayne, .	Honesdale, .	W. Richardson, .										
9	Susquehanna,	Silver Lake, .	E. Rose, .	52.10	64.97	55.97	77.00	36.00	57.68	.	35.00	47.70	.
10	Luzerne, .	Wilkesbarre, .	W. F. Dennis, .										
11	Schuylkill, .	Port Carbon .	P. C. Lyceum, .	50.27	70.37	53.43	83.00	36.50	58.02	.	33.00	46.05	.
12	Berks, .	Reading, .	C. F. Egelmann, .	56.50	66.00	55.37	78.00	43.00	59.29	.	...	...	.
13	Chester, .	West Chester,	Wm. W. Jefferies, .	56.50	69.13	65.83	81.00	39.50	63.82	.	36.00	51.64	.
14	Delaware, .	Haverford, .	Haverford School, .										
15	Lancaster, .	Lancaster, .	Conservatory of Arts,	55.19	71.52	58.33	82.50	41.50	61.68	1⅓	38.50	51.78	.
16	York, .												
17	Lebanon, .												
18	Dauphin, .	Harrisburg, .	J. Heisely, .	58.11	67.54	63.69	76.00	44.00	63.11	3⅔	46.00	56.72	5
19	Northumberland,	Northumberland,	Andrew C. Huston,	58.55	65.52	58.98	75.00	41.00	60.05	⅓	33.00	45.53	.
20	Columbia, .	Danville,	C. H. Frick.										
21	Bradford, .												
22	Tioga, .												
23	Lycoming, .												
24	Union, .												
25	Mifflin, .												
26	Juniata, .	Mifflintown, .	J. A. Rinkead, .	48.34	72.50	51.42	83.50	33.00	58.42	3⅓	....	....	.
27	Perry, .												
28	Cumberland, .	Carlisle, .	Prof. W. H. Allen,										
29	Adams, .	Gettysburg, .	Prof. M. Jacobs, .	53.58	69.21	57.79	81.00	36.50	60.19	.	34.00	49.20	.
30	Franklin, .												
31	Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	53.37	70.17	56.93	82.00	36.00	60.16	2	....	....	.
32	Centre, .	Bellefonte, .	John Harris, .	46.75	68.89	55.12	79.00	31.50	56.92	10	....	....	.
33	Potter, .												
34	M'Kean, .	Smithport, .	Richard Chadwick,	46.93	66.55	50.29	78.00	32.00	54.59	1	25.00	42.43	.
35	Clearfield, .												
36	Cambria, .	Ebensburgh,	Richard Lewis, .	47.38	65.92	50.70	77.00	33.00	54.67	2⅓	30.00	41.14	1
37	Bedford, .	Bedford, .	Samuel Brown, .	54.52	69.71	60.59	80.00	36.00	61.54	1	....	....	.
38	Somerset, .	Somerset, .	George Mowry, .	48.05	61.82	51.55	72.50	34.00	53.81	1⅓	31.00	43.97	2
39	Indiana, .	Indiana, .	Richard White, .	58.93	64.50	54.40	75.00	40.00	59.28	.	....	....	.
40	Jefferson, .	Rose Cottage,	C. C. Gaskell, .										
41	Warren, .	Warren, .	C. S. Brown, .	55.50	62.17	60.08	73.00	45.00	59.25	6	45.00	54.71	6
42	Venango, .	Franklin, .	Wm. Connely, .	46.33	70.33	55.90	84.00	32.00	57.52	.	....	....	.
43	Armstrong, .												
44	Westmoreland,												
45	Fayette, .	Uniontown, .	J. P. Weithers, .	52.90	69.27	55.65	30.50	28.50	59.27	.	....	....	.
46	Green, .												
47	Washington, .	Cannonsburg,	A. H. Campbell, .										
48	Alleghany, .	Pittsburgh, .	J. P. Bakewell, .	59.44	68.44	62.62	78.00	46.00	63.50	5⅓	....	....	.
49	Beaver, .	Beaver, .	Wm. Allison, .	53.40	69.52	55.97	86.00	36.00	59.63	1	....	....	.
50	Butler, .	Butler, .	Jacob Mechling, .	52.60	66.57	59.63	77.00	40.00	59.60	.	....	....	.
51	Mercer, .	West Greenfield,	S. Campbell, .										
52	Crawford, .	Meadville, .	J. Limber, .	57.11	68.27	58.04	84.00	45.00	61.14	3⅔	40.00	49.64	8
53	Erie, .	Erie, .	Park & Reid, .										

No.	County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1	Philadelphia	30.18	30.12	30.15	30.39	29.71	30.15	⅓	25	6	.	9	....	....	..	2.100
3	Bucks	30.06	30.04	30.04	30.30	29.60	30.04	⅓	17	10⅓	2⅓	9	....	....	..	3.122
5	Northampton	30.01	29.98	29.99	30.30	29.70	29.99	7	.	.	.	....	....	....	..	.....
9	Susquehanna	28.14	28.16	28.17	28.34	27.60	28.16	.	13⅔	16⅓	.	7	....	....	..	2.180
11	Schuylkill	29.38	29.41	29.42	29.63	28.88	28.40	.	15⅔	14⅓	.	6	....	....	..	1.492
12	Berks	29.93	29.94	29.91	30.16	29.44	29.92	.	16⅓	13⅔	.	8	....	....	..	1.487
13	Chester	30.39	30.39	30.38	30.62	30.08	30.39	.	.	.	.	8	....	....	..	......
15	Lancaster	29.55	29.56	29.54	29.81	29.06	29.55	1⅔	19⅓	9	1⅔	7	....	....	..	1.830
18	Dauphin	29.81	29.78	29.77	30.03	29.40	29.79	3⅔	.	.	.	5	....	....	1	1.534
19	Northumberland	29.53	29.51	29.50	29.78	29.11	29.51	⅓	10⅓	19⅓	⅓	10	....	....	..	1.278
26	Juniata	29.56	29.53	29.54	29.81	29.13	29.54	3⅔	13	12⅔	4⅓	....	....	....	..	......
29	Adams	29.46	29.43	29.44	29.70	29.01	29.45	.	20⅓	9⅔	.	7	....	....	..	1.543
31	Huntingdon	29.42	29.39	29.41	29.69	28.99	29.41	2	.	.	.	7	....	....	..	1.354
32	Centre	29.35	29.34	29.35	29.60	29.09	29.35	11⅓	11	8⅔	10⅓	....	....	....	..	2.468
34	M'Kean	28.15	28.22	28.12	28.40	27.80	28.16	1⅓	10	18⅔	1⅓	8	....	....	..	2.925
36	Cambria	27.93	27.96	27.95	28.24	27.60	27.95	2⅓	12	13⅔	4⅓	10	....	....	..	2.525
37	Bedford	29.32	29.31	29.27	29.59	23.90	29.30	1	17	12	1	....	....	....	..	......
38	Somerset	28.04	28.04	23.04	28.29	27.66	28.04	1⅓	13	15⅔	1⅓	5	...	....	..	1.545
39	Indiana	28.71	28.70	28.70	29.00	28.30	28.70	.	19	11	.	10	....	....	..	2.670
41	Warren	28.88	28.87	28.86	29.14	28.41	28.87	6	17	7	6	....	....	...	..	......
42	Venango	29.08	29.12	29.11	29.70	23.60	29.10	.	17⅔	11⅔	⅔	6	....	....	..	1.335
45	Fayette	29.05	29.08	29.06	29.38	23.71	29.06	.	24⅔	5⅓	.	....	....	....	..	......
48	Alleghany	29.36	29.32	29.33	29.68	28.92	29.34	5⅓	9⅔	15	5⅓	6	....	....	..	2.204
49	Beaver	29.50	29.48	29.48	29.80	29.06	29.49	1⅓	17	11⅔	1⅓	....	....	....	..	......
50	Butler	28.91	28.91	28.91	29.20	28.60	28.91	.	.	.	.	7	...	....	..	3.545
52	Crawford	28.86	28.84	28.85	29.08	28.42	28.85	3	13	14	3	9	....	....	..	3.891

No.	County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1	Philadelphia	3	.	1⅓	.	1⅓	⅓	.	⅓	3⅔	1⅓	3⅓	⅓	3⅓	⅓	8	1	.	3⅓
3	Bucks	2	1⅓	1⅓	.	.	.	.	⅔	⅓	1	7	.	⅓	⅔	14	⅓	.	⅔
5	Northampton	1	.	1⅔	.	⅓	.	⅔	.	1	.	8	.	3	.	9⅓	.	.	5
9	Susquehanna	⅓	.	.	.	⅔	.	⅔	.	3	.	5⅔	⅓	10⅓	⅔	8⅓	.	.	.
11	Schuylkill	1⅓	.	1	.	3	⅓	2	.	2⅔	.	4	1⅓	2⅔	⅔	2	⅓	8⅓	.
12	Berks	1	.	1	.	.	.	⅔	.	⅓	.	5⅔	.	2	.	19⅓	.	.	.
13	Chester	5⅔	.	⅔	.	2	.	1⅓	.	4⅓	.	3	.	5	.	8	.	.	.
15	Lancaster	3⅔	⅓	.	⅔	⅓	.	1	.	5⅔	⅓	5	.	⅔	1	5	4⅔	.	1⅔
18	Dauphin	3⅔	.	⅔	.	⅔	.	1⅓	.	3⅔	.	2	.	3⅔	.	10⅔	.	.	3⅔
19	Northumberland	3	.	3⅓	.	1⅔	.	4	.	4⅓	.	1	⅓	4	⅓	5⅓	.	2⅓	⅓
26	Juniata	.	.	⅓	.	⅓	.	1⅔	.	.	.	3⅔	.	1	.	4⅔	.	14⅓	4
29	Adams	5	.	1	.	.	.	1	⅔	2	2	4⅓	1	2	⅓	5	⅓	5	⅓
31	Huntingdon	.	.	.	.	6⅔	.	.	.	.	.	.	.	21⅓	.	.	.	.	2
32	Centre	2	.	1⅓	.	.	.	.	.	.	⅔	1⅔	⅓	3⅔	.	3	⅓	3⅓	13⅔
34	M'Kean	.	.	.	.	4	.	2	.	.	.	3⅓	.	12⅓	.	3	.	.	5⅓
36	Cambria	1⅔	.	.	.	.	.	⅔	.	2⅓	.	4⅓	1	6	⅓	7⅔	⅔	3	2⅓
37	Bedford	.	⅓	.	.	.	.	2⅓	2	.	.	5⅔	3	⅔	8	6	1	.	1
38	Somerset	1	.	.	.	.	.	1⅓	.	.	.	6	⅔	4⅔	1⅓	2	.	11⅔	1⅓
39	Indiana	.	.	.	.	⅓	⅔	2	.	.	.	5⅔	.	6⅓	.	3⅓	.	11⅔	.
41	Warren	⅓	.	⅔	.	.	.	1	.	⅓	⅔	4⅓	.	.	.	2⅔	⅔	13⅓	6
42	Venango	.	.	.	.	.	.	4⅓	.	.	.	5	.	⅓	.	19⅓	.	.	1
45	Fayette	⅓	.	1⅓	.	.	.	.	.	⅔	.	7⅔	.	6⅔	.	7	.	6⅓	.
48	Alleghany	⅓	.	.	.	1	.	3	.	⅓	.	1⅔	.	5	⅓	1⅓	.	11	6
49	Beaver	.	.	1⅔	⅓	1⅔	.	4	.	.	.	4	.	1⅓	⅔	9	⅓	5⅔	1⅓
50	Butler	.	.	⅓	.	6⅓	.	1⅔	.	⅔	.	5	.	13	.	3	.	.	.
52	Crawford	2	.	.	.	⅔	.	.	.	6⅓	.	3⅓	.	3⅓	⅓	8⅔	.	2⅓	3

No.	County.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Philadelphia	....	.	... .	....	.	1289
3	Bucks	....	.	.....	....	.	1277
5	Northampton	....	.	... ..	....	.	1258
9	Susquehanna	....	.	.....	....	.	1233
11	Schuylkill	....	.	.....	....	.	1279
12	Berks	....	.	......	....	.	1241
13	Chester	....	.	......	....	.	1313
15	Lancaster	55.11	3	.....	61.72	3	1245
18	Dauphin	....	.	......	....	.	1217
19	Northumberland	....	.	.....	62.48	1	1243
26	Juniata	....	.	.....	....	.	1231
29	Adams	....	.	.....	....	.	1250
31	Huntingdon	....	.	.....	....	.	1255
32	Centre	....	.	.....	....	.	1256
34	M'Kean	....	.	.....	64.07	2	1234
36	Cambria	....	.	.....	...	.	1237
37	Bedford	....	.	.. .	....	.	1242
38	Somerset	....	.	.....	....	.	1246
39	Indiana	....	.	...	....	.	1304
41	Warren	....	.	....	....	.	1230
42	Venango	....	.	.....	....	.	1232
45	Fayette	....	.	.....	....	.	1271
48	Alleghany	....	.	......	....	.	1244
49	Beaver	....	.	.....	....	.	1278
50	Butler	....	.	.....	....	.	1239
52	Crawford	....	.	.....	....	.	1241

	Co	Bar 9, P. M.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1		30.12	.	$1\frac{2}{3}$	$\frac{1}{3}$	$5\frac{1}{3}$	.	.	$7\frac{1}{3}$	....	.	....	....	.	1291
2															
3		30.02	.	$\frac{1}{3}$	$1\frac{1}{3}$	10	$\frac{1}{3}$	.	$1\frac{1}{3}$	....	.	.....	....	.	1278
4															
5															
6															
7															
8															
9		28.04	.	7	.	$9\frac{1}{3}$	.	.	.	....	.	.....	....	.	1330
10															
11		29.40	.	5	$\frac{1}{3}$	$2\frac{2}{3}$	$\frac{2}{3}$	8	.	....	.	.....	....	.	1280
12		29.90	$\frac{1}{3}$	$1\frac{2}{3}$	.	18	.	$\frac{1}{3}$	.	....	.	......	....	.	1256
13	(														
14	I														
15	I	29.52	$1\frac{2}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$	$4\frac{2}{3}$	$1\frac{1}{3}$	.	$\frac{2}{3}$	52.38	2	.....	56.93	2	1262
16	I														
17	I														
18	I	29.76	.	3	.	$12\frac{1}{3}$	.	.	$1\frac{1}{3}$	....	.	......	....	.	1251
19	I	29.48	.	$5\frac{1}{3}$	.	$2\frac{1}{3}$	$\frac{1}{3}$	.	$2\frac{2}{3}$	....	.	......	56.29	.	1252
20	(														
21	I														
22	T														
23	I														
24	U														
25	N														
26	J	29.52	.	$2\frac{1}{3}$	.	$5\frac{2}{3}$	.	$13\frac{2}{3}$	2	....	.	.....	....	.	1255
27	F														
28	C														
29	A	29.43	$\frac{1}{3}$	$1\frac{1}{3}$	1	$6\frac{2}{3}$	.	.	.	....	.	.....	....	.	1282
30	F														
31	H	29.36	.	18	.	.	.	.	$\frac{2}{3}$	....	.	.....	....	.	1275
32	C	29.26	$\frac{1}{3}$	$5\frac{1}{3}$	.	$3\frac{1}{3}$	.	$2\frac{2}{3}$	$15\frac{2}{3}$	....	.	.....	....	.	1260
33	P														
34	M	28.09	$\frac{1}{3}$	14	.	3	.	.	4	....	.	.....	63.50	18	1300
35	C														
36	C	27.88	2	$7\frac{2}{3}$	.	$6\frac{1}{3}$	.	$1\frac{1}{3}$	4	....	.	.....	....	.	1261
37	B	29.26	$\frac{1}{3}$	5	.	$2\frac{2}{3}$	8	.	.	....	.	.. .	....	.	1254
38	S	27.95	4	$3\frac{1}{3}$	$\frac{2}{3}$	3	.	$7\frac{1}{3}$	$5\frac{2}{3}$	....	.	.....	....	.	1253
39	Ir	28.62	.	$8\frac{2}{3}$	.	2	.	$6\frac{2}{3}$	$6\frac{1}{3}$	....	.	...	....	.	1305
40	Je														
41	W														
42	V	29.14	.	.	.	16	.	.	$\frac{1}{3}$	....	.	.....	....	.	1257
43	A														
44	W														
45	F	29.04	.	4	.	$5\frac{2}{3}$	.	4	.	....	.	.....	....	.	1272
46	G														
47	W	29.08	.	$12\frac{1}{3}$	.	$2\frac{2}{3}$	.	1	$2\frac{1}{3}$	....	.	......	....	.	1302
48	A	29.30	1	$6\frac{2}{3}$	$\frac{1}{3}$	$1\frac{2}{3}$	.	10	$\frac{1}{3}$	....	.	......	....	.	1258
49	B	29.46	.	$1\frac{1}{3}$	.	13	$\frac{2}{3}$	$5\frac{1}{3}$	$\frac{2}{3}$	....	.	......	....	.	1377
50	B	28.83	.	$12\frac{2}{3}$	.	1	.	.	.	....	.	.....	....	.	1259
51	M														
52	C	28.73	$\frac{2}{3}$	3	$\frac{2}{3}$	2	.	.	9	....	.	.....	....	.	1274
53	Er														

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

OCTOBER, 1840.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia,	Philadelphia,	J. M. Hamilton,	54.71	58.98	52.19	70.50	36.00	55.29	4⅓	30.00	48.04	5
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	48.15	52.73	49.32	72.75	30.00	52.39	⅔	26.00	42.63	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,										
6 Monroe	Stroudsburg,	A. M. Stokes,										
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	43.74	55.74	48.81	70.00	27.00	49.43	.	24.00	39.84	.
10 Luzerne,	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon	P. C. Lyceum,	43.84	62.08	46.97	83.50	25.00	50.96	.	24.00	39.18	.
12 Berks,	Reading,	C. F. Egelmann,	48.45	57.48	50.29	74.00	27.00	52.07	.	...	...	.
13 Chester,	West Chester,	Wm. W. Jefferies,										
14 Delaware,	Haverford,	Haverford School,										
15 Lancaster,	Lancaster,	Conservatory of Arts,	49.35	62.53	52.50	81.00	29.00	54.79	⅔	27.00	45.92	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	50.65	56.83	51.89	71.00	32.00	53.12	2	30.00	47.90	2
19 Northumberland,	Northumberland,	Andrew C. Huston,	46.52	56.87	50.06	73.00	27.00	51.15	.	21.00	39.71	.
20 Columbia,	Danville,	C. H. Frick,										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Rinkead,	43.15	61.85	47.24	79.50	21.00	50.74	2⅓	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	45.84	59.40	50.06	75.50	27.50	51.60	.	24.00	42.18	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	45.13	62.86	49.29	77.00	23.00	52.43	⅔	....	....	.
32 Centre,	Bellefonte,	John Harris,	41.98	59.46	46.66	71.50	18.00	49.37	10	....	....	.
33 Potter,												
34 M'Kean,	Smithport,	Richard Chadwick,	40.39	55.52	40.03	76.00	23.00	45.31	.	19.00	36.23	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	42.66	55.41	44.50	78.00	12.00	47.52	4	12.00	38.34	2
37 Bedford,	Bedford,	Samuel Brown,	46.04	61.12	50.59	81.50	24.00	52.58	.	....	....	.
38 Somerset,	Somerset,	George Mowry,	44.17	55.69	47.00	71.50	19.00	48.95	5	17.00	38.16	6
39 Indiana,	Indiana,	Richard White,	50.72	57.64	45.88	78.00	22.00	51.41	6⅓	....	....	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,										
42 Venango,	Franklin,	Wm. Connely,	40.83	65.00	50.39	79.00	22.00	52.07	2	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weithers,	49.13	62.98	47.98	87.50	18.00	53.36		....	....	.
46 Green,												
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,	32.81	47.03	35.90	64.00	14.00	38.58	.	14.00	28.70	.
48 Allegheny,	Pittsburgh,	J. P. Bakewell,	52.23	59.00	53.08	75.09	29.00	54.77	.	....	....	.
49 Beaver,	Beaver,	James Allison,	46.29	64.18	48.97	81.00	22.00	53.14	1	....	....	.
50 Butler,	Butler,	Jacob Mechling,	47.42	59.87	53.19	82.00	24.00	53.49	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,	55.37	58.28	46.47	81.00	28.00	53.37	1⅓	18.00	33.66	2
53 Erie,	Erie,	Park & Reid,										

Barometer. — Weather.

County.	Bar. 7, A. M.	Bar. 2, P. M.	Bar. 9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia	30.12	30.09	30.12	30.41	29.60	30.11	5⅓	15	10⅓	5⅔	8	....	....	..	6.900
3 Bucks	30.04	30.02	30.02	30.31	29.57	30.02	⅔	15⅓	13	2⅔	15	....	....	..	6.202
9 Susquehanna	28.09	28.15	28.04	28.50	27.70	28.09	.	10	21	.	6	2	....	..	2.980
11 Schuylkill	29.39	29.35	29.40	29.61	28.93	29.38	.	15⅓	15⅔	.	11	2	....	..	5.688
12 Berks	29.89	29.87	29.90	30.16	29.44	29.89	.	14⅔	16⅓	.	9	....	....	..	3.676
15 Lancaster	29.53	29.49	29.52	29.78	29.01	29.51	⅔	16⅓	14	⅔	9	....	....	..	4.595
18 Dauphin	29.78	29.74	29.76	30.03	29.32	29.76	2	.	.	.	9	1	....	..	4.227
19 Northumberland	29.49	29.47	29.48	29.73	29.01	29.48	.	12⅔	18⅓	.	12	1	....	1	3.960
26 Juniata	29.53	29.49	29.52	29.80	29.04	29.51	2	15	13⅔	2⅓	5	1	....	..	......
29 Adams	29.44	29.43	29.43	29.68	29.87	29.43	.	17	14	.	12	....	....	..	7.118
31 Huntingdon	29.38	29.35	29.36	29.59	28.92	29.36	⅔	18	12	.	8	1	....	..	3.395
32 Centre	29.32	29.38	29.26	29.61	28.49	29.32	10	10⅔	9⅓	11	6	....	....	..	4.182
34 M'Kean	28.08	28.10	28.09	28.25	27.80	28.09	.	11	20	.	10	3	....	..	3.578
36 Cambria	27.89	27.88	27.88	28.10	27.51	27.88	4	10⅓	15⅓	5⅓	10	1	....	..	3.636
37 Bedford	29.26	29.24	29.26	29.45	28.80	29.25	.	16	15	.	....	....	....	..	......
38 Somerset	27.95	27.94	27.95	28.14	27.60	27.95	5	11⅓	14⅔	5	8	2	....	..	2.972
39 Indiana	28.64	28.62	28.62	28.90	28.30	28.62	6½	12⅓	12⅓	6⅓	....	....	....	..	......
42 Venango	29.10	29.07	29.14	29.90	28.51	29.10	⅓	14⅔	16	⅓	9	1	....	..	3.323
45 Fayette	29.03	29.02	29.04	29.21	28.60	29.03	.	22⅔	8⅓	.	7	....	....	..	3.100
47 Washington	29.06	29.02	29.08	29.35	28.54	29.05	.	10⅓	15⅔	5	6	1	....	..	2.970
48 Allegheny	29.30	29.29	29.30	29.50	28.86	29.30	.	11⅔	18	⅓	10	....	....	..	3.051
49 Beaver	29.45	29.42	29.46	29.68	29.10	29.44	⅔	15	14⅔	1⅓	7	1	....	..	3.473
50 Butler	28.84	28.83	28.83	29.00	28.50	28.83	.	.	.	.	10	....	....	..	3.877
52 Crawford	28.74	28.71	28.73	28.96	28.40	28.73	1⅓	15⅓	14⅓	1⅓	14	1	....	..	6.153

Winds.

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1 Philadelphia	⅓	.	1⅔	.	⅓	⅓	2⅔	.	4⅓	⅔	5⅔	.	1⅔	⅓	5⅓	.	.	7½
3 Bucks	.	⅓	4	⅔	1	1	2⅔	⅓	⅔	⅓	6⅔	.	⅓	1⅓	10	⅓	.	1⅓
9 Susquehanna	1⅔	.	.	.	.	.	1⅔	1⅓	4⅓	.	5⅔	.	7	.	9⅓	.	.	.
11 Schuylkill	⅓	⅓	1⅔	⅓	2⅓	.	3⅓	.	3⅓	.	2⅔	.	5	⅓	2⅔	⅔	8	.
12 Berks	.	.	2⅔	.	1⅓	.	2⅓	.	1⅓	⅔	2⅓	⅓	1⅔	.	18	.	⅓	.
15 Lancaster	3	⅓	⅓	.	2	1⅓	4⅔	⅔	2	2⅓	3	1⅔	1⅓	1⅓	4⅔	1⅓	.	⅔
18 Dauphin	⅓	.	.	.	.	.	8⅓	.	2	.	3⅔	.	3	.	12⅓	.	.	1⅓
19 Northumberland	4⅓	.	4	.	2⅓	.	3⅔	⅓	3⅓	.	⅓	.	5⅓	.	2⅓	⅓	.	2⅔
26 Juniata	⅓	.	1⅓	.	⅔	.	3⅓	.	.	.	1⅔	.	2⅓	.	5⅔	.	13⅔	2
29 Adams	2⅓	.	3	.	.	.	3⅔	1	3⅓	2	6⅓	⅓	1⅓	1	6⅔	.	.	.
31 Huntingdon	.	.	.	.	12⅓	.	.	.	.	.	.	.	18	.	.	.	.	⅔
32 Centre	⅓	⅓	.	.	.	.	.	.	1⅔	⅓	1	⅓	5⅓	.	3⅓	.	2⅔	15⅔
34 M'Kean	.	.	.	.	2⅓	.	5⅓	.	.	.	2	⅓	14	.	3	.	.	4
36 Cambria	.	.	.	.	.	.	3⅔	.	2⅔	.	3⅓	2	7⅔	.	6⅓	.	1⅓	4
37 Bedford	.	.	.	.	.	1	3	.	2	2⅔	6⅓	⅓	5	.	2⅔	8	.	.
38 Somerset	⅓	.	.	.	⅓	.	1⅔	.	⅔	.	4	⅓	3⅓	⅔	3	.	7⅓	5⅔
39 Indiana	.	.	.	.	⅓	.	1⅓	.	⅔	.	5	.	8⅔	.	2	.	6⅔	6⅓
42 Venango	.	.	⅓	.	.	.	7⅓	.	.	.	7	.	.	.	16	.	.	⅓
45 Fayette	1⅓	.	⅔	.	.	.	⅓	.	4	.	11	.	4	.	5⅔	.	4	.
47 Washington	3⅓	.	2⅓	.	3	.	1⅔	.	.	.	2⅓	.	12⅓	.	2⅔	.	1	2⅓
48 Allegheny	⅓	.	⅔	⅓	3	⅔	2⅓	.	⅓	⅔	2⅔	1	6⅔	⅓	1⅔	.	10	⅓
49 Beaver	.	.	1⅓	.	⅓	.	3⅔	1	.	.	3⅔	.	1⅓	.	13	⅔	5⅓	⅔
50 Butler	⅓	.	3	.	5⅔	.	1	.	⅓	.	7	.	12⅔	.	1	.	.	.
52 Crawford	2⅓	.	.	.	⅓	.	1⅓	⅓	5⅔	1⅓	4⅓	⅔	3	⅔	2	.	.	9

Hygrometer.

County.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia	....	.	....	....	.	1291
3 Bucks	....	.	.....	....	.	1278
9 Susquehanna	....	.	.....	....	.	1330
11 Schuylkill	....	.	.....	....	.	1280
12 Berks	....	.	......	....	.	1256
15 Lancaster	52.38	2	.....	56.93	2	1262
18 Dauphin	....	.	......	....	.	1251
19 Northumberland	....	.	......	56.29	.	1252
26 Juniata	....	.	.....	....	.	1255
29 Adams	....	.	.....	....	.	1282
31 Huntingdon	....	.	.....	....	.	1275
32 Centre	....	.	.....	....	.	1260
34 M'Kean	....	.	.....	63.50	18	1300
36 Cambria	....	.	.....	...	.	1261
37 Bedford	....	.	.. ..	....	.	1254
38 Somerset	....	.	.....	....	.	1253
39 Indiana	....	.	...	....	.	1305
42 Venango	....	.	.....	....	.	1257
45 Fayette	....	.	.....	....	.	1272
47 Washington	....	.	......	....	.	1302
48 Allegheny	....	.	......	....	.	1258
49 Beaver	....	.	......	....	.	1277
50 Butler	....	.	.....	....	.	1259
52 Crawford	....	.	.....	....	.	1274

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

MAY, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 224.]

7. *Comparison of the effects of high and low overshot wheels.*—The Committee next proceed to compare the deductions made for the overshot wheel No. I, with the results for Nos. II, III, and IV. The following table presents the ratio of effect to power in wheel No. II, fifteen feet in diameter.

TABLE EIGHTEENTH.

Showing the ratio of effect to power with overshot wheel No. II. Taken from table a. (Vol. ix, 2nd series, p. 298.)

Table.	Head above gate. Feet.	Head and fall. Feet.	Width of aperture. Feet.	Ratio of effect to power.	Mean ratio.	Table.	Head above gate. Feet.	Head and fall. Feet.	Width of aperture. Feet.	Ratio of effect to power.	Mean ratio.
a I.	5.50	20.50	1.00	.746	.746	a II.	1.50	16.50	1.75	.841	.840
"	3.00	18.00	1.00	.801		"	1.00	16.00	1.75	.855	.855
"	"	"	1.50	.818	.809	"	0.84	15.84	"	.830	.830
a II.	1.50	16.50	1.50	.840		"	0.75	15.75	"	.841	.841
				Mean	.777					Mean	.841

The average ratio with the low heads is the same as with wheel No. I. *Eighty-four per cent. of the power expended may, as before, be relied on for the effect.*

The falling off of the ratios at heads bearing a considerable proportion to the fall, is also distinctly seen, although the coefficients are not entirely regular in their increase.

We have now a satisfactory test to apply in ascertaining whether

the effect of an overshot wheel under different heads of water above the gate may be calculated by supposing the effect made up of the impulse from the water striking the buckets and of the gravity of the water in the subsequent descent.

As in the case before calculated, (pp. 323–4) the water is accelerated after leaving the aperture, and a virtual head corresponding to the distance from the bottom of the gate to the bottom of the bucket is to be found.* This, added to the head above the gate, is the head of impulse to which the undershot coefficient is to be applied.

The head above the bottom of the bucket, taken from the head and fall gives the height to which the theoretical overshot coefficient is to be applied. The sum of the products thus found, divided by the head and fall gives a coefficient which should correspond with the ratio actually found, if the principles and details of the calculation are correct.

The data are specified in the table which follows, with the particulars of the calculation. In the last two columns a comparison is made between the numbers thus calculated and the ratios actually found in the foregoing table.

TABLE NINETEENTH.

Comparison of the calculated with the observed ratios of effect to power, in overshot No. II.

Head above gate. Feet.	Effective head of impulse. Feet.	Product of effective head by undershot coefficient.	Product of fall, from bottom of bucket to bottom of wheel by overshot coefficient	Sum of product of effective fall by overshot coefficient and head by undershot.	Head and fall. Feet.	Calculated ratio of effect to power.	Ratio of effect to power by experiment.	Difference
5.50	7.12	2.02	12.73†	14.75	20.50	.720	.746	—.026
3.00	4.62	1.31	"	14.04	18.00	.780	.809	—.021
1.50	3.12	0.89	"	13.62	16.50	.826	.840	—.014
1.00	2.62	0.74	"	13.47	16.00	.843	.855	—.012
0.84	2.46	0.70	"	13.43	15.84	.848	.830	+.018
0.75	2.37	0.67	"	13.40	15.75	.851	.841	+.010
							Sum of errors	—.045
							Mean	—.007

* Gate *c* was used in these experiments. Whether the actual velocity of the efflux is increased by this gate or not, its effects are calculable upon such a supposition; we have, therefore, adopted $(.72)^2$ as a divisor in deducting the effective head corresponding to the distance between the bottom of the gate and the bottom of the bucket (.85 ft.)

† The fall is 14.15 ft., and the overshot coefficient is taken at .9 to facilitate the calculations.

The greatest difference between calculation and experiment being less than three per cent., the result may be considered as entirely satisfactory. The average error is but one per cent.

The accordance of the effects obtained from wheels Nos. I and II is thus shown to be complete, the effect of the increased proportion which the part where the water begins to escape from the wheel to the effective fall being, however, perceptible.

In the following table the results of experiments with wheels Nos. III and IV, are combined. The first was ten and the second six feet in diameter.

The form of gate by which water was admitted to the wheel having been changed,* the effective impulse for a given head above the gate is somewhat varied, but as the effect of this correction would merely be perceived in the cases of the higher heads, and as these differ but little more from the results of calculation, than the low ones, it has been thought better not to make any correction on this account.

TABLE TWENTIETH.

Comparison of the calculated with the observed ratios of effect to power, overshot wheels Nos. III and IV.

Head above gate. Feet.	Effective head of impulse. Feet.	Product of effective head by undershot coefficient.†	Product of fall from bottom of bucket to bottom of wheel by overshot coefficient	Sum of last two named products.	Head and fall. Feet.	Calculated ratio of effect to power.	Experimental ratio of effect to power.	Difference
0.25	1.87	0.52	8.46	8.98	10.5	.855	.817	+.038
0.75	2.37	0.66	"	9.12	11.0	.829	.809	+.020
1.75	3.37	0.94	"	9.40	12.0	.783	.758	+.025
2.75	4.37	1.22	"	9.68	13.0	.745	.710	+.035
3.75	5.37	1.50	"	9.96	14.0	.711	.670	+.041
							Mean difference	+.032

* For this gate, c, plate vii., Jour. Frank. Inst. vol. x., the ratios of the actual to the theoretical discharge per second, is : .62 : 1.

† Assumed at .28.

Comparison of the calculated with the observed ratios of effect to power, overshot wheel No. IV.

Head above gate. Feet.	Effective head of impulse. Feet.	Product of effective head by undershot coefficient	Product of fall from bottom of bucket to bottom of wheel by overshot coefficient	Sum of last two named products.	Head and fall. Feet.	Calculated ratio of effect to power.	Experimental ratio of effect to power.	Difference
0.25	1.68	0.47	4.95	5.42	6.5	.834	.810	+.024
0.75	2.18	0.61	"	5.56	7.0	.794	.793	+.001
2.75	4.18	1.17	"	6.13	9.0	.680	.645	+.035
3.75	5.18	1.45	"	6.40	10.0	.640	.604	+.036
							Mean difference	+.024

The calculated ratios exceed the observed ones less than three per cent. at a mean. The effect of wheel No. IV, appears rather better than that of No. III, perhaps, in part, from its having been raised so that the top was nearer to the gate.

It follows from these experiments that *low overshot wheels may be used to nearly the same advantage as high ones*, the diminution of effect when the wheels are duly arranged, amounting to but about three per cent., in a comparison between a wheel of twenty feet and one of six feet diameter. The conclusion on page 149, in reference to question 1, is thus shown to be applicable to low as well as high overshot wheels. As this is an important conclusion, the Committee will again consider the proofs afforded of it by the experiments.

The introduction of the virtual head of impulse in these calculations, while it is certainly more accurate in a theoretical point of view, tends to render the calculations more difficult in practice. A mode of calculating the effective power of an overshot wheel when the head and fall of water and the dimensions of the wheel are given, is desirable for practice; hence the following table has been compiled to show that, practically, the head above the bottom of the bucket may be used with the undershot coefficient, in calculating the effect of impulse, the fall below the bottom of the bucket being taken as the factor for the overshot coefficient. In fact, the less rigid mode of calculation produces results, on the average, more nearly in accordance with experiment than the other mode.

TABLE TWENTY-FIRST.

Comparison of the ratio of effect to power in overshot wheels under different heads, as calculated upon the head above, and fall below, the bottom of the bucket, with the ratio found by experiment.

Head above bottom of bucket.	Product of head above bottom of bucket by .28.	Product of fall below bottom of bucket by .9, added to preceding product.	Head and fall.	Calculated ratio of effect to power.	Observed ratio of effect to power.	Difference.
			Overshot wheel No. I.			
3.60	1.01	18.47	23.00	.800	.828	—.028
2.10	0.59	18.05	21.50	.839	.842	—.003
1.35	0.38	17.84	20.75	.860	.845	+.015
					Mean	—.005
			Overshot wheel No II.			
6.35	1.78	14.51	20.50	.708	.746	—.038
3.85	1.08	13.81	18.00	.767	.809	—.042
2.35	0.66	13.39	16.50	.811	.840	—.029
1.85	0.50	13.23	16.00	.826	.855	—.029
1.69	0.47	13.20	15.84	.833	.830	+.003
1.60	0.45	13.18	15.75	.836	.841	—.005
					Mean	—.023
			Overshot wheel No. III.			
1.10	0.31	8.77	10.50	.835	.817	+.018
1.60	0.45	8.91	11.00	.810	.809	+.001
2.60	0.73	9.19	12.00	.796	.758	+.038
3.60	1.01	9.47	13.00	.728	.710	+.018
4.60	1.29	9.75	14.00	.696	.670	+.026
					Mean	+.020
			Overshot wheel No. IV.			
1.00	0.28	5.23	6.50	.805	.810	—.005
1.50	0.42	5.37	7.00	.767	.793	—.026
3.50	0.98	5.93	9.00	.660	.645	+.015
4.50	1.26	6.21	10.00	.621	.604	+.017
					Mean	—.000
		General average of the differences for the four wheels				+.002

The sums of the positive and negative errors in this calculation more nearly balance each other than in the former. A very easy practical rule is thence deducible for calculating the effective power of an overshot wheel.

If the ratio of effect to power in a theoretical overshot wheel, or one where allowance is made for loss by the head of water above the top of the wheel, as deduced from the high and low wheels, is the same as we have already found it to be, it follows, as before stated, that low wheels are as effective in practice as high ones, in proportion to the head and fall of water. To exhibit this by reference to the experiments themselves, and without additional calculations, the following table has been prepared. Part first contains a selection from tables sixth, (p. 149,) nineteenth, (p. 290,) and twentieth, (p. 291,) of those heads above the gate, which have a less ratio to the head and fall, than about one to six or seven. Under the separate designations of the wheels, are given the heads above the gate, the head and fall, the ratio of the head above the gate to the head and fall, and the observed ratio of effect to power. Part second of this table contains the same data differently arranged, namely, according to the order of the ratios of each head to the head and fall. The three columns of this second part contain the ratio just referred to, the designation of the wheel, and the ratio of effect to power, as found by experiment.

TABLE TWENTY-SECOND.

PART FIRST.
Showing the ratio of effect to power with different overshot wheels, under different heads, bearing a small proportion to the head and fall.

Head above gate.	Head and fall.	Proportion of head to head and fall.	Ratio of effect to power.	Head above gate.	Head and fall.	Proportion of head to head and fall	Ratio of effect to power.
Overshot wheel No. I.				Overshot wheel No. II.			
0.50	20.75	.024	.845	0.75	15.75	.048	.841
1.25	21.50	.058	.842	0.84	15.84	.053	.830
2.75	23.00	.120	.828	1.00	16.00	.062	.855
				1.50	16.50	.091	.840
	Mean	.067	.838				
Overshot wheel No. III.					Mean	.063	.841
0.25	10.50	.024	.817	Overshot wheel No. IV.			
0.75	11.00	.068	.809	0.25	6.50	.038	.810
1.75	12.00	.146	.758	0.75	7.00	.107	.793
	Mean	.079	.795		Mean	.072	.801

PART SECOND.
Containing the same data as part first, arranged in the order of the proportion of head, to head and fall.

Proportion of head to head and fall	Number of wheels.	Ratio of effect to power.
.024	No. I.	.845
"	" III.	.817
.038	" IV.	.810
.048	" II.	.841
.053	" II.	.830
.058	" I.	.842
.062	" II.	.855
.068	" III.	.809
.091	" II.	.840
.107	" IV.	.795
.120	" I.	.828
.146	" III	.758

The mean ratios deduced from part first of the foregoing table, if arranged in the order of the proportion of head to head and fall, would stand thus:

Wheel No. II.	Proportion of head to head and fall, .063.	Ratio of effect to power,	.841
I.	" " " .067.	" "	.838
IV.	" " " .072.	" "	.801
III.	" " " .079.	" "	.795

The increasing series of proportion of head and fall has corresponding to it a decreasing series of ratios of effect to power, in which wheel No. II, of fifteen feet in diameter, has a higher ratio than No. I, of twenty feet, and No. IV, of six feet, a higher ratio than No. III, of ten feet. The increase in the mean proportion of head to head and fall, between the first and last average, just given, is much greater than the decrease of ratio in the same cases. Taking the average of all the ratios of effect to power, given in part second of the last table, it appears that in calculating the effect of an overshot wheel, even as small as six feet in diameter, *eighty-three per cent. of the power may be taken for the effect,* provided the head above the gate does not exceed one-eighth of the head and fall, and the wheel is running so as to give the maximum ratio of effect to power.

The second deduction in regard to the overshot wheel, had reference to the ratio of the velocity of the wheel to that of the water striking it (page 150.) The following table gives a similar comparison for wheel No. II.

The velocity of efflux, of the water having been calculated, as explained on page 150, the virtual head corresponding to it, is obtained according to the principles laid down in page 153. To this is added the distance from the bottom of the gate to the bottom of the bucket, and the velocity of the impinging water, is calculated from this head.

In the table, the head above the gate, the whole effective head of impulse, the velocity of the water, the velocity of the wheel, and the ratio, are arranged in successive columns.

TABLE TWENTY-THIRD.

Showing the relative velocity of the Water and Wheel. Overshot No. II.

Table whence taken.	Head above bottom of gate.	Effective head of impulse.	Velocity of water.	Velocity of wheel.	Ratio.
	Feet.	Feet.	Feet.	Feet.	
a. I.	5.50	2.99	13.87	7.45	.54
"	3.00	1.89	10.74	5.55	.52
"	"	1.83	10.83	6.44	.59
a. II.	1.50	1.16	8.58	5.44	.63
"	"	1.14	8.50	5.66	.66
"	1.00	0.90	7.60	4.35	.57
"	0.84	0.83	7.31	4.72	.64
"	0.75	0.77	7.02	3.41	.48
				Mean	.58

This coefficient will be seen to be nearly the same with those obtained with gates *b* and *c*, in wheel No. I. The conclusion drawn before, as to the constant ratio between the velocity of the wheel and of the water, is entirely confirmed. The evidence is the more important because the head is in this wheel varied from three quarters of a foot to five feet and a half. The two extremes of the table vary most from the law, which is in favour of its accuracy, since in the one case, the distance gone through after leaving the aperture, bears a very small proportion to the whole effective head, and in the other case, is nine-tenths of it.

The apertures having been but little varied in the case of this wheel, it does not admit of conclusions in regard to the effect of the quantity of water or the velocity of the wheel.

We are enabled to compare the effective velocity of the gate c, used in this wheel, and *a*, *b*, and *c*, used with No. I, and the effect will be found favourable to the three last, and against c. Thus it appears from table tenth, that the velocity of the water striking the buckets was under a head of 2.75 ft., 13.89 ft., and 11.65 feet, with the gates *b*, and *c*, respectively, while with *c*, from the table just given, under a three feet head, it was at a mean of but 10.78 ft., the fall after leaving the gate being the same in each case. In consequence of this, the velocities of this overshot wheel, do not, at a mean, come up to those of No. I, agreeing more nearly with the velocities given with gate *a*, than with the others.

There is nothing, however, in this to invalidate the conclusion above drawn, in regard to the relative velocity of the water and of the wheel.

It is plain that an increase of velocity must, in this wheel, produce a greater decrease of effect than in No. I, owing to the greater proportion which the head necessary to give the velocity required, will bear to the fall.

[TO BE CONTINUED.]

Technical Employment of Indigo. Part III. By J. C. Booth.

CONCLUDED FROM PAGE 231.

The indifferent character of indigo rendering it almost impossible to combine it with organic fibres, it is usual to submit it to one of two operations in order to effect its combination, either by reducing it to colourless indigo, or by solution in sulphuric acid, both of which processes were described in Part II. The modes of reduction vary according to the nature of the reducing material, for in the process referred to, it takes place in the cold, but where fermentation is resorted to, heat is usually applied.

1. *Copperas or common blue vat, cold vat.*—The principles of this process, as well as the mode of conducting it, were described in parts I and II, but the proportion of materials may vary according to their several qualities. Thus the following recipes are given among others.

Indigo,	1	1	1	6
Copperas,	2	3	4	15
Lime,	3	4	2	20
Potash,			2	4

The copperas should be as free as possible from peroxide of iron, which exerts no reducing influence, and from sulphate of copper, which would reoxidize the reduced blue colour. The lime is supposed to be in the dry hydrated state, that is, slaked with a quantity of water just sufficient to reduce it to a fine powder, and a due proportion of this hydrate should be employed, for an excess forms an insoluble compound with the reduced indigo occasioning an equal loss in the vat. This vat is adapted to silk, cotton, and linen, which are dipped into the yellow liquid after it has settled, suffered to remain in it a short time, taken out and exposed to the air, the oxygen of which acting on the reduced indigo, converts it into its characteristic blue shade. A weak bath and a single dipping may be sufficient for a light blue, but any desired shade may be attained by a more concentrated bath and more frequent dipping, observing to expose the fabric to the air after each dipping, until it receives its full depth of blue. After the last operation, the dyed materials are dried, treated with very dilute sulphuric or muriatic acid, to separate the lime, and finally rinsed in pure water. It appears then that the chief object to be attained by the reduction of indigo, is to render it soluble, so that it may enter into a fibrous texture, and then and there be converted into the blue by the operation of the air.

2. *Orpiment and tin vats.*—These are chiefly employed in printing goods, but their use depends on the same principles as those of the cold vat. For the former, one part finely powdered indigo, two parts potash, and 175 parts of water, are boiled; one part of freshly slacked lime is added, and the whole again boiled; and lastly, one part of orpiment (sulphuret of arsenic,) is added, and the mixture suffered to stand. It is usually thickened with gum, and applied by the hand or block. In this operation the arsenic and sulphur are oxidized at the expense of the indigo, which, in its reduced state, forms a soluble compound with the lime, while the generated acids of sulphur and arsenic combine with the potassa. The operation being tedious, and requiring much care in preparation, has given place to the frequent employment of oxide of tin instead of orpiment.

The following compositions are employed, the first for the block, and the second for cylinder printing.

Caustic soda lye,	$=3\frac{1}{2}$ galls.	$3\frac{1}{2}$ galls.
Hydrated protoxide of tin,	$=5\frac{1}{4}$ lbs.	5 lbs.
Finely ground indigo,	$=3\frac{1}{2}$ lbs.	$3\frac{1}{2}$ lbs.
Raw sugar,	$=21$ lbs.	
Venice turpentine,		3 lbs.
Gum,		11 lbs.

The caustic lye should be of speci. grav. 1.15; the protoxide of tin is precipitated from a solution of protomuriate of tin by carbonate of potassa; the sugar and gum are used merely for thickening. The operation with the protoxide of tin depends on its affinity for oxygen, which converts it into the peroxide, while the indigo is simultaneously reduced and combines with soda. Turpentine is employed, in the second instance, in order to obviate the rapid reoxidation of indigo in the atmosphere; it being less necessary in the first case, since the mixture is kept more excluded from the atmospheric action. If a solution of muriate of tin be substituted for a portion of the precipitated protoxide, the mixture is less subject to oxygenation.

3. *Warm and fermented, or pastel, vat.*—Woad, indigo, madder, bran, potash, and lime, are employed, in this vat; the proportions of which necessarily vary; but the following may serve to show its usual composition; fifty woad, four indigo, three madder, two potash and caustic lime. The iron, copper, or wooden vat, is filled with water, and heated to 160° Fahrenheit, while the four ingredients are introduced; the temperature is maintained several hours, during which, slacked lime is gradually added, until one and one-third of caustic lime has been expended. The vat is now suffered to cool, during which, lime is again added in small portions. A fermentation ensues; the blue colour passes into green, and when the smell of acetic acid is perceptible, the liquid assumes a yellowish colour, and is ready for dyeing operations.

The theory of the process is analogous to that of the cold vat. The madder, woad, and bran, abounding in starch, sugar, gluten, &c., enter readily into fermentation in warm water, in order to maintain which, they abstract oxygen partly from the air, and in part from the indigo; the latter being thus reduced or deoxidized, forms a soluble combination with potassa, which is partially rendered caustic by lime. A portion of indigo-brown is dissolved with the blue, but is again precipitated by lime. Among other products of fermentation, carbonic and acetic acids are generated, which are neutralised by lime, and hence the gradual addition of this earth in proportion as they are produced. Woad simply dried, is better than the fermented

colouring material, for the latter is apt to become putrefied, an accident that sometimes happens, and may be remedied by more indigo and alkaline matter in the original proportion of ingredients. A quantity of lime should be added nearly sufficient to neutralise the generated acids, in order to keep the indigo in solution, and yet preserve a slight acidity in the bath, for if the fluid be alkaline it combines with the extractive matter, and forms an insoluble compound with indigo-blue, which is thus rendered inert. In a healthy state of the bath, therefore, lime has the property of rendering the potash more caustic and powerful, of precipitating indigo-brown, which would deteriorate the blue colour, of keeping the blue in solution, and of neutralising an excess of acidity.

4. *Urinous vat.*—This method of dyeing with indigo has been superseded in larger establishments by the preceding, and is now only practised on a small scale. Its operation depends on the fermentation of warm urine, by which the indigo is reduced, and combines with ammonia simultaneously generated.

5. *Potash vat.*—In this bath, indigo, madder, bran, and potash are employed, the last being added in several successive portions, while the bath is maintained at 122° Fahrenheit. The theory of the operation is similar to that of the pastel vat, excepting that only a small quantity of lime is added towards the close of the operation, to check fermentation, and precipitate indigo-brown. This vat is said to be superior to the pastel vat, although more expensive in materials, by requiring less time in dyeing, penetrating cloth better, by keeping sound for a longer time, and by requiring less outlay in its preparation.

6. *Sulphuric indigo vat.*—The theory of this solution was discussed in Part II. It is usually termed the Saxon blue dye, having been discovered by a Saxon of the name of Barth. As water prevents, more or less, the proper action of the acid, the fine indigo should be dried, and the sulphuric acid boiled, if it be not perfectly concentrated. One part of indigo is gradually added to six to eight parts of the acid, always taking care to prevent the mixture from becoming warm by keeping the vessel in cold water, where the temperature of the air is too high, for the action of the ingredients generates heat, and might destroy a portion of the blue colour. The mixture is suffered to stand thirty-six to forty-eight hours in a moderately warm place, which effects solution, and prevents the acid from attracting moisture. It may then be diluted with any desired quantity of water, and filtered, or drawn off clear. If goods be dyed in this solution, the red, brown, and glutinous matters of indigo are also attached to the material with the blue, which would therefore be deteriorated in its

beauty of shade. To avoid this, the indigo-blue (or ceruleo) sulphuric acid may be prepared by attaching it to wool, as described in Part II, washing with water, digesting in water containing a little carbonated alkali, and afterwards adding a little dilute sulphuric acid to the solution. By attaching it to the wool, gluten remains; by digestion with alkali, the indigo-red remains on the wool; and by the last addition of acid, indigo-brown is precipitated, while the alkali is supersaturated. The last clear solution communicates a fine blue colour to wool.

Probably the best method of preparing a fine blue is to add to the sulphuric solution of indigo about twenty times its volume of water, and add potash until one-fourth or one-third of the alkali is saturated. The ceruleo-sulphate of potassa precipitates, (see Part II,) which, being dissolved in water and acidulated, produces the finest Saxon blue. The liquid, separated from the precipitate, may be employed for a less perfect shade of colour. Materials to be dyed in the sulphuric blue vat should be dipped into a solution of alum, and then into the blue liquid, to which an excess of carbonate of potassa has been added, by which means a basic ceruleo-sulphate of alumina is attached to the fibres; or they may be dipped into a warm solution of chloride of barium and bitartrate of potassa, and then into an acid solution of the blue liquid, which produces a precipitate of neutral ceruleo-sulphate of baryta; the latter is more permanent than the former, but at the same time, more expensive.

It is difficult to ascertain the amount of indigo annually employed in dyeing, but it is probable it cannot fall short of 14 to 15,000,000 pounds. In England, about 1,700,000 pounds were imported in 1785, 3,600,000 in 1800, 5,000,000 in 1820, and over 7,000,000 in 1836.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

[Translated from the German, by L. Klein, Civil Engineer.]

[continued from page 255.]

LETTER X.

5. *Railroads in England.*

Although it is maintained that the oldest railroads were found in the mines in Germany, the merit of first having railroads used for the transportation of passengers, and of having introduced upon them

locomotive engines, belongs to the engineers and mechanics in England. It is only to be regretted that the immense cost of construction of the English railroads, and the expenses of working many of those where inclined planes have been adopted, have produced very unfavourable results for the Stockholders, and a bad impression on the subject of railroads on the continent. The railroad which is generally held up as an example for all others, viz. that from *Liverpool to Manchester*, is thirty-one miles in length, and has cost, up to the 31st of December, 1837, according to the report of the Directors, £1,360,095 stg., or per mile, 213,228 dollars. If the average be taken for the first three and a half years, during which the road has been in operation, the charge per passenger per mile, was three and three quarter cents, or one-fourth less than on the American railroads. Upon the Liverpool and Manchester railroad, there are transported, annually, 500,000 passengers, 250,000 tons of merchandize, and 100,000 tons of coal. The gross income was, in the year 1837, £226,000 stg., or per mile of road, 35,431 dollars, which income is indeed 11½ times as large as on the American railroads, where it averages only 3075 dollars per mile; but compared with the cost of construction of 20,000 dollars, and 213,228 dollars per mile, we find the income in America to be fifteen per cent., and only one per cent. more on the Liverpool and Manchester railway. This explains why the net income of this road, upon which there is a greater traffic than on any other railroad in the world, was never more than seven to eight per cent. on the capital of construction; the Stockholders, though, received an annual dividend of from nine to ten per cent., but only for the reason that over £500,000 stg. have been obtained in loans at four per cent., the surplus interest on this capital therefore devolves upon the shares and increases the dividends.

The second great railroad, of 112 miles in length, extends from *London to Birmingham*, and cost £4,500,000 stg., or 195,000 dollars per mile. The other railroads in England generally cost less than these two, but still too much to serve as models for the works on the continent. Even in England, the shares of only five railroads are now over par, those of all other railroads are, notwithstanding the low rate of interest, sold below par. In the whole, there are now in England about 800 miles of railroads in operation, of which about 300 miles serve only for the transportation of coal. If to these 800 miles be added 300 miles for Austria, 150 miles for the other States of Germany, 150 miles for France, 159 miles for Belgium, and seventeen miles for Russia, we have, in total, 1576 miles of railroads now in operation in Europe, while, already at the close of 1838, 3000 miles of railroads were completed in the United States of America.

6. *Railroads in Russia.*

Until the year 1834, when I first went to Russia, the engineers there regarded railroads as quite impracticable for that empire. On my application, His Majesty, the Emperor, gave me an exclusive privilege for the formation of two railroad companies, the one for a railroad from *St. Petersburg to Zarskoe Selo,* and the other, for one from St. Petersburg to Peterhof. I formed afterwards a company for the establishment of the first railroad, and the charter for the same was granted on the 21st of March, 1836. Soon after the construction of the road was commenced, it was partly opened already on the 21st of September, 1836, and the whole line was put into operation on the 30th of October, 1837. This railroad is only seventeen miles long, but forms, in its whole length out of the city of St. Petersburg, a straight line; the greatest rise is within the city, and but 10½ feet per mile. An embankment was erected the whole length of the road, which contains over one million cubic yards; this embankment was covered with a bed of stone and gravel, fourteen inches high, upon which the cross ties or sleepers were laid three feet from each other, supporting iron rails of sixty-five pounds per yard, which were fastened in chairs upon every sleeper. The space between the cross ties was then filled in with broken stone or gravel, and covered with sand. The grandeur of the whole structure was in correspondence with the expected traffic, as it was estimated that 300,000 passengers each way, or 600,000 in the whole, will travel over this road in one year. But this solidity in the construction, the high price of the iron in the year 1836, and of the stones and gravel in the marshy district of St. Petersburg, as also a great many unforeseen expenses, which generally take place in a new enterprize of this kind, increased the cost of construction so much, that for the road itself of seventeen miles in length, with a single track, 4,000,000 of rubles were expended, which is 50,000 dollars per mile. This comprises, however, the purchase of six locomotive engines, forty-four passenger cars with 1878 seats, and nineteen freight cars. The company having got permission to erect a large hotel in the park, at Pawlowsky, and another at Zarskoe Selo, they expended for these two hotels, and for some other buildings, 1,000,000 of rubles; therefore, in the whole, 5,000,000 of rubles, or 1,050,000 dollars.

During the winter of 1837—1838, the Directors of the Company permitted only a few trips to be made during some days of the week; the daily regular trips between St. Petersburg and Zarskoe Selo, commenced on the 4th of April, and those to Pawlowsky, on the 22nd of May, 1838. According to the printed report, made to the

Stockholders at their general meeting, the results of the operations of this road for the year 1838, have been as follows, viz:

The number of passengers from 1st April to 31st December 1838, was - - - - - -	597,665
If reduced to the whole length of the road, this number is equal to - - - -	423,129
The total receipts from passengers, were -	161,872 dollars.
Each passenger paid, therefore, at an average, for seventeen miles, - - - -	38¼ cents.
Which gives the average charge, per passenger per mile, - - - - - -	2¼ cents.

The number of trips made by the locomotives, was 3500, and the average number of passengers per trip, 121. All the trains together, performed, therefore, a distance of 59,500 miles. The current expenses have been:

For maintenance of way and buildings, -	$ 23,485
Transportation account, - - -	36,810
General expenses, cost of administration, &c.,	30,340
Expenses for amusements, - - -	14,226
Total,	$ 104,861

If this sum be compared with the number of miles traveled by all the trains, or 59,500, we find the expense per mile of travel, equal to 180 cents. In Belgium this expense is only 105 cents, and the trains contain, at an average, 143 passengers. In America, the expense per mile of travel, is only 100 cents, while the average number of passengers in a train, is forty.

The expense per mile of travel, 180 cents, divided by 121, gives 1.49, or nearly one and a half cent as the expense per passenger, per mile, which is twice as much as on the Belgium railroads.

The gross income during nine months, was 161,872 dollars, the net income, according to the accounts, 63,068 dollars, or thirty-eight per cent. of the gross receipts. The Stockholders received a dividend of four per cent. for these nine months.

The Directors mention in their report, that during the *whole* first year the road has been in operation, the number of passengers was 707,091, and the gross income 193,734 dollars. For the next year they estimate the income at 23,579 dollars, and declare, that there is a prospect, the net profit will be over forty per cent. of the gross revenue. In this case, the net profit would be 92,632 dollars, and after deducting 18,947 dollars for the interest and sinking fund on the loan, there will remain 73,685 dollars as dividend for the Stockholders, or exactly ten per cent. on the capital stock of 736,850 dollars. The

whole result of the operations agree very accurately with my first estimates; the number of passengers reduced to the whole length of the road, will be 600,000 per year; and already three years ago, I offered the company to rent the rail road, and pay the Stockholders during three years, a dividend of ten per cent. per annum.

The experience in the management of railroads during the last three years, has, however, shown that the expenses are much larger than was formerly expected, and at the present time, when this experience from the railroads in Europe, and a much greater one from those in the United States is before me, I must declare that it is quite impossible to defray the current expenses of the Zarskoe-Selo railroad, as it is now managed, with sixty per cent. of the gross income. As yet, this railroad is not reduced to its own resources, because the Directors proposed to make another loan of 300,000 rubles, (63,158 dollars,) to complete the same; and as long as money is expended at the same time, for the construction of the road and its operations, there can, even with the best will, never be made a strict division of the expenditure. No accurate results concerning the expenses of the operations of the Zarskoe Selo railroad, will therefore be obtained in 1839, and as long, hereafter, as the construction account is not entirely closed.

Several months since I proposed to the Directors, some arrangements and improvements, from which none but the best results can be expected. They consist, principally, in the following:

1. To continue the railroad from its present termination, to, and along, the Fontanka canal, a few wersts, in order that passengers might be taken from different points in the city, and brought, by horse power, to the general depot. All the large cities in the United States, as New York, Philadelphia, Baltimore, and New Orleans, are traversed by railroads, which, with a peculiar construction, turn round the sharp corners of the streets frequently with a radius of only forty feet, and the eight-wheeled cars, of fifty-two feet in length, never run off the track. The advantage of continuing the railroads through cities, is very great for the Stockholders and the public in general, principally where the lines are short.

2. To introduce eight-wheeled passenger cars and American locomotive engines, and to apply to their purchase the reserved fund, which, according to the statutes, is to be from ten to thirty per cent. every year of the gross income, and destined for the renewal of the depreciated stock.

3. To use wood as fuel for locomotive engines. The coke hitherto used as fuel upon this road, is imported from England at a very high price. There is no coal between St. Petersburg and Moscow, and it

can never be expected that the fuel for such an immense railroad as that between those two cities, will be procured in the same way. My attention in America was therefore also directed to this subject; upon more than 100 railroads, wood is used here as fuel, and it was to be expected that something effective had been invented, to prevent the throwing out of the sparks. It was principally in the South, under the thirtieth degree of latitude, that I found an apparatus in use, which seems to answer perfectly in every respect. By means of this apparatus the sparks are led through a partial vacuum, and fall down to the bottom of the smoke box; there is no wire net on the top of the chimney. This apparatus has been in operation for eighteen months, during which time not a single accident occurred, although cotton and other articles are daily transported in open cars. It is easy to show that by the use of wood as fuel upon the Zarskoe Selo railroad, the sum of 10,000 dollars might be saved in one year.

It is only with the introduction of the above stated improvements, that the Stockholders of the Zarskoe Selo railroad may expect a dividend of ten per cent. per annum, and as I am now so well acquainted with the experience in America, I do not hesitate to offer them again a yearly dividend of ten per cent. for the next three years to come, to pay besides, 90,000 rubles per year as interest and sinking fund on the loan, and to pay for the general depreciation of the locomotives and cars, an American train consisting of a locomotive with tender and a number of passenger cars to accommodate 400 passengers.

The advantage of the construction of the Zarskoe Selo railroad to the Russian empire, is far greater than to the Stockholders therein interested; because this railroad has been used in the changeable climate of St. Petersburg, in summer and winter, without the least interruption, the trips were regularly continued during the time of the greatest frost and the severest snow storms, and every body became convinced of the practicability and usefulness of this new kind of communication. This favourable result has produced the effect, that the project for a railroad from *St. Petersburg to Moscow*, which I brought into notice already three years ago, finds every day more and more supporters, and at present there are certainly but few individuals in Russia, and none abroad, who, with the knowledge of the intercourse existing between the two cities, are not convinced of the utility and necessity of this railroad. The population of St. Petersburg is 470,000, that of Moscow 330,000; the population of the towns and other places on the road, exceeds 200,000 souls. This railroad would therefore, in its length of 420 miles, form a line of communication for one million of inhabitants, residing on the same; and besides, the railroad would be traveled over by those numerous

travelers, who, from all parts of the empire, pass through Moscow to St. Petersburg.

The enormous intercourse between the two cities, which is not to be met with on any other line, neither in nor out of Europe, may be best judged of from an account kept, by order of His Majesty the Emperor, of all vehicles which passed over the turnpike from the 1st of January to the 31st of December, 1834. In that year, there were counted at Tshetire-ruki, on the turnpike road to Moscow, five miles from St. Petersburg:

	96,201	traveling carriages of every description, drawn by - - -	269,799 horses.
	23,879	post carriages and post sledges,	62,171 "
	1,133,603	freight wagons or sleighs, drawn by - - -	1,187,402 "
Total,	1,253,683	vehicles, drawn by	1,519,372 horses.

This intercourse is so great, that it would justify the construction of a railroad more than it was ever the case in any line of this length; it remains only to inquire what would be the cost of construction of this railroad.

The Americans have constructed 3000 miles of railroads, and expended for the same, at an average, 20,000 dollars per mile; as only 35,000 passengers, and 15,000 tons of goods are transported annually over these roads, they have but single tracks, and the whole management is such, that the capital of construction bears five and a half per cent. interest. The traffic upon the St. Petersburg and Moscow railroad will be at least ten times as great, and therefore a much larger capital may be invested there than in America.

Already in the year 1835, I personally made a preliminary survey of the country between St. Petersburg and Moscow, and convinced myself that in the greatest part of the line the country is uncommonly favourable; since that time, I have continued to collect every important information in regard to this railroad, and with the knowledge of the experience in America, I may state without hesitation, that a railroad from St. Petersburg to Moscow, with a double track, with as heavy rails as those upon the Zarskoe Selo railroad, with all the necessary buildings and outfit, may be established for the sum of 125,000,000 of rubles, (26⅓ millions of dollars,) and that I will undertake to finish the whole railroad in a term of not more than six years.

It will, perhaps, be objected, that the Zarskoe Selo railroad, of 17 miles in length, with but a single track, has cost 5,000,000 of rubles, that therefore, in proportion to the length, the 420 miles to Moscow must

cost 125,000,000, in which sum would be comprised, it is true, the purchase of the proportional number of 150 locomotive engines and of 1600 passenger and freight cars, but the railroad could only have a single track. I have had occasion to remark already, in my former reports, that the cost of one railroad can not lead us to determine the cost of another, as the expenses of construction can only be ascertained by the special estimates; but here it may also be remembered that of the whole cost of the Zarskoe Selo railroad, the fifth part was expended for buildings alone, which, in proportion to the length, would give 25,000,000 rubles for the railroad to Moscow. The cost of the buildings for this road, however, as they will be constructed solely to accommodate the traffic, and not for amusements, will not be more than 4,000,000 rubles, and the remainder 21,000,000 are, with the present prices, just sufficient for making the superstructure of the second track throughout the whole line. There only remains therefore, the expense of grading for the second track to be provided for, and this sum will be richly brought in by the introduction of such a construction of the railway as will conform to the present experience in the two continents.

The connection of the centre of the Russian empire with the most important commercial city in the South—of *Moscow with Odessa*—has also been hitherto regarded as highly important. The construction of a canal is quite impossible; the construction of a turnpike, and more yet, its maintenance, would, with the entire deficiency of stone and gravel, be too expensive. Nearly all the railroads in the Southern States of North America, as also those in Belgium, are constructed without stone or gravel, because the latter are as rare there as in Russia; and in every case, would the maintenance of a railroad between Moscow and Odessa be cheaper than a macadamized road. The distance between the two cities is about double that from Moscow to St. Petersburg, and as the country is, throughout, very level, there is no difficulty to construct this railroad, with a double track, and heavy rails, for 175,000,000 of rubles, (or 37,000,000 of dollars) at the most. Both railroads could easily be completed in ten years.

A third railroad, which is supported, principally, by the population of Moscow, is that from *Moscow to Kolomna*, and the river Oka. The surveys and plans for this railroad were made by several engineers, during three years, from 1836 to 1838, with all the necessary detail, under my superintendence, and the estimates now completed. The length of the railroad to the river Oka, is $66\frac{2}{3}$ miles, and plate rails of sufficient strength, (manufactured in Russia,) might be employed for the same. The railroad would have a single track with sidings, and the arrangement be such that no inconvenience would

be experienced in the operations. The passengers, and no doubt, also a great quantity of goods, would be transported from the end of the railroad upon the river Oka to Nishney Novgorod, situated on the confluence of the rivers Oka and Wolga, where, annually, the celebrated great fair is held for the merchants of Europe and Asia. According to my estimates, made here, the railroad and four steamboats, would cost 11,000,000 of rubles, (2,315,800 of dollars,) and I offer to complete the road in two years, provided that I meet with no obstacles in directing the construction.

The way in which the above mentioned capitals for the construction of the railroads, may be procured, will be easily found out, if my former nine letters are read with attention. Sixteen millions of Americans have, within ten years, completed 3000 miles of railroads, at an expense of 60,000,000 of dollars; why should not Russia, whose European possessions are as large as the United States, and populated by three times as many, or 48,000,000 of inhabitants—why should this immense empire not also expend, in ten years, the sum of 60,000,000 of dollars for the railroads between St. Petersburg, Moscow, and Odessa. In Belgium, 56,618 soldiers were carried, last year, upon the railroads; what a gain would not result to the Russian war department alone, from the establishment of railroads! With the adopted width of track of six feet, and the introduction of the American plans of construction, horses, cannons, munition, wagons, and all other objects, will be transported with the greatest facility, and it might be proved, that the saving in the cost of transportation of the Russian troops and their munitions, during the late three wars with Persia, Turkey, and Poland, would have covered the whole cost of construction of the railroad from St. Petersburg to Odessa; and besides, the duration of the war would have been materially shortened.

Times were never more favourable for great enterprizes; Europe is in the enjoyment of profound peace; money may be obtained at the lowest rate of interest, and will be easily procured for the Russian undertakings, if to their partakers, advantages and guarantees are allowed, similar to those given in other parts of Europe, and in the United States of America. In such large undertakings, however, for which more than the ability of the natives is required, the question of nationality must be laid aside, and every body must be regarded as a native, who has made himself meritorious by the introduction of useful objects, which promote the prosperity of the nation. The Russian government has, principally in the last four years, accomplished what may be termed enormous; it can, and will, therefore, also execute that grand and national work.

Extracts from the Treatise on Geodesy. By L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[Translated for the Journal of the Franklin Institute.]

The translation of Francœur's work on Geodesy, was commenced for the purpose of improving the translator's knowledge of a subject which forms a part of the duties of his corps. It has since occurred to him that the work would be useful to the public.

The frequent demands made by the general and state governments for topographical information with regard to particular localities, induces the belief that at some day not far distant, our legislatures, both state and national, will follow the example of other civilized governments, and consummate the desirable object of having complete maps of the territory within their respective limits.

The great survey of the coast undertaken by the general government, and conducted by Mr. Hassler, is, in fact, the commencement of this system, and will form the basis of all minor surveys of the different states and the inland frontier.

Even with the present demand for information upon the subject of surveying, the work cannot be unacceptable, as it will tend to give form, precision, and consistency, to surveys conducted for internal improvements and local purposes.

The name of the illustrious author, Francœur, renders unnecessary any commendation of his treatise. It may not be improper to say, however, that it is considered in Europe, the standard work on geodesy.

The valuable notes interspersed through the text, are by Major Bache, of the Topographical Engineers, to whom the translator feels an obligation which he is sure will be shared by the reader.

Book 1*st.—Topography.*

1. If we take a portion of country and suppose perpendicular lines to pass through every point, the intersection of these lines with a horizontal plane will form what is called the plan. The projection of the plan is composed of these intersections represented on paper. In this are to be traced the sinuosities of rivers and roads, the outlines of woods, the boundaries of fields and enclosures, and all the other features of the country, both natural and artificial.

Every part, when represented, preserves its true relation of size, form, and distance, reduced by a scale, and presents the same appearance as if the whole of the objects were seen at the same time from a great elevation, with a glass, which diminished their size.

Topography teaches the projection of plans, leveling, and land surveying, or the measurement of areas, and the art of delineating ground. This last division not involving geometrical considerations, will be omitted in this treatise.

CHAPTER 1ST.—*The Projection of Plans.*

We shall explain the construction and use of the different instruments required in topography, except those used in geometrical drawings, such as the rule, the triangle, the dividers, the drawing pen, &c., which are too well known to require a notice here.

The art of projecting plans consists chiefly in a knowledge of instruments, and the merit of the surveyor depends, in a great measure, on his skill in using them.

2. *The Scale.*—Every plan should be accompanied by a scale, which shows the proportion the plan bears to the ground. The most usual way of making a scale is to draw on the plan a right line, which is divided into equal parts, and numbered; each part designating an unit, as a mile, a foot, an inch, or a tenth of a foot, &c. In Fig. 2, plate 1, one of these parts is divided into tenths. If it is required to take off four units and six tenths, place one leg of the dividers on the division No. 4, and the other on the subdivision No. 5, on the left hand of zero. If the unit represents a foot, we obtain four feet and five tenths, or fifty-four inches; if a mile, four miles and six tenths.

The relation between the distances on the plan and the objects themselves, is frequently expressed by a fraction. If for example, a foot on paper represents a mile on the ground, the scale of the plan may be expressed by the fraction one five thousand two hundred and eighty; a foot being the $\frac{1}{5280}$ part of a mile.*

The plans of the great map of France, by Cassini, are on a scale of $\frac{1}{86400}$, a line [.091 of an inch,] representing 100 toises, [221.5 yards.] The scale adopted by the war department, is $\frac{1}{80,000}$, a millemetre, [.3937 of an inch] representing eighty metres, [87.491 yards.] The scales used in the *cadastre*,† are $\frac{1}{5000}$, $\frac{1}{2500}$, and $\frac{1}{1250}$, and as the ground is more or less cut up into small parcels, a millemetre, [.3937 of an inch,] representing in these cases, 5, [5.4658 yards,] $2\frac{1}{2}$, [2.7329 yards,] or $1\frac{1}{4}$ metres, [1.3664 yards.]

3. When great precision is required, the transversal scale‡ is used. Fig. 3 is a scale of this kind. The least part that can be measured is

* The French now use a metrical system, viz., a myriametre, a kilometre, a hectometre, a decometre, a metre, &c., each unit of division being a tenth of the next greater one.

† The public register, in which is recorded the quantity and value of lands (like the doomsday book in England.)

‡ Commonly called diagonal scale.

extremely small, as it is contained 100 times in each principal longitudinal division, or ten times in every sub-division. The oblique lines enable us to measure the small parts in the following manner. Place one leg of the dividers on the transverse line marked 300, and the other upon the oblique one numbered eighty, the distance being measured along the longitudinal line No. 4, (for it is necessary that both legs of the dividers should be on the same longitudinal line,) the length measured will contain 384 parts, which will be 384 tenths of inches, feet, yards, or miles, according to the value assigned to the unit of division.

4. *The Protractor.*—This instrument, represented in figures 5, 6, and 8, is used to trace angles on paper, or to measure them when traced. It is a semicircle of brass or horn, divided into degrees and half degrees, from 0° to 180°. It is numbered either from the right or the left, and on a concentric semicircle it is numbered in a contrary direction, from 180° to 360°, in order to measure the arcs, which exceed 180°.

To measure an angle already traced on paper, apply the diameter of the protractor to one of the sides, A C, (fig. 7,) so that the centre shall be on the apex C of the angle, the other side, C K, cuts the circumference in a point, K, where we read the angle, which is 54°.

To construct an angle L O K, (fig. 6,) of an even number of degrees, thirty-six for example, place the protractor so that the radius of the thirty-sixth degree shall fall on the line I K, which is to be one of the sides of the angle, and at the same time, place the edge *ab* on the point E, through which we wish the other side to pass. The line L O, which, by the construction of the protractor, is parallel to the diameter A C, will make an angle of 36° with the line O K.*

These protractors, however, afford but an imperfect means for measuring or constructing angles, and as an improvement, that represented in fig. 8, has been contrived. It consists of a graduated semicircle as before, with a movable rule, to which is attached a vernier, by the aid of which minutes can be read, (vide No. 9, on the use of the vernier and its construction.) The centre of the circle is in the middle of an opening, which is defined by the crossing of two hairs. Care must be taken in the construction of the instrument that the edge I D of the

* In this example the angle is drawn through a point removed from the given line. A more frequent case is where the point is on the line. Then the diameter of the protractor is placed on the given line, with the centre at the point, when the required angle is marked off. A perpendicular to the given line should be drawn, in the first instance, through the point, to guide in laying down the protractor in its true position, as the line passing through the graduation at 90°, should be coincident with it.

rule prolonged, shall, in all its positions, pass through the centre of the circle*. However, it is still more exact to use a scale of cords. Fig. 4 is a scale of cords. To use it, describe first the arc of a circle, A K, (fig. 7,) with a radius equal to the cord of 60°, (taken from the scale,) which we know is the side of the inscribed hexagon; then take from the scale, with the dividers, the cord of the given angle, 54° for example, apply it to the arc described, and the radii drawn through the two points, A K, where the points of the dividers touch the arc, will make with each other the required angle. To save space, fig. 7 is drawn from scale fig. 4: the distances being reduced to one-fifth.

To give this construction greater precision, in place of taking the length of the cord from fig. 4, calculate the length in parts of the radius by means of the equation No. 35, or take the numerical value from the table, (see Francœur's course of Math. and his Geometry;) then take this distance with the dividers from a decimal scale, which will be the length of the cord to be applied to the arc A, K. Thus the cord of 54° is 9080, the radius being 10.000: with

* The circular protractor is a still more perfect instrument, and gives results of far greater accuracy. It is numbered throughout the entire circle from 1° to 360°, and reads by means of verniers to one minute, 30, 15, and in some instances, to 10 seconds; the diameter of the instrument varying according to the minuteness of the divisions. It is furnished with arms provided with points, by means of which the given angle is marked on the paper. These arms, for safety and convenience in transportation, fold up on the body of the instrument. This protractor has the advantage, not possessed by those less than a circle, of correcting by means of opposite verniers, the errors of eccentricity, &c., which belong, more or less, to all graduated instruments. It is, likewise, susceptible of ready adjustment, and is not easily deranged. The movement of the arms is effected by a pinion working on a fine ratchet on the periphery of the circle. For laying down the protractor on any given point, four short lines are marked on the interior edge of the principal circle, which indicate the prolongation of two lines at right angles to each other, and intersecting at the centre of the instrument.

The description of another protractor, and one which has found general favour for railroad, canal, and other surveys, within the last few years, may not be unacceptable in this place. It is likewise circular, and consists of a printed sheet so designed, by means of lines of unequal lengths, that the divisions of 10°, 5°, and 1°. and the fractional parts of a degree, readily catch the eye. It is prepared without letters or figures, in order that the draftsman may assume any one of the principal divisions for the zero or meridian line, as best may suit his purpose. The original plate for printing these protractors, was engraved in 1829, and had a circle of twelve inches in diameter graduated to fifteen minutes. It was sufficiently large to print on medium paper, without leaving any marginal ridge, which is always made when the paper is larger than the plate. To avoid the error which would otherwise occur, the impressions are obtained on dry paper; though this precaution is not sufficient to secure absolute accuracy to the protractors, as the great pressure necessary to give the lines sufficient distinctness, stretches out the paper unequally, which, on coming from the press, assumes its original form. The figure thus becomes slightly elliptical, but not so much so as to offer any practical objection to the usefulness of the plan. The facilities which this protractor affords in plotting, generally, will readily suggest themselves. It is hardly necessary to say, it is not intended for use in final drafts or maps, but to obtain results to be transferred to them.

a radius of 10,000 parts of any scale, describe the arc A K, upon which apply the cord A K of 9080 parts of the same scale.

5. *Signal Staves.*—These are straight poles shod with iron that they may be stuck in the ground. A small white board or a sheet of paper is fastened to these staves when it is required to see them at a great distance.* They are planted in different parts of the country as signals, and may be used to run straight lines, by an observer getting two of them in range, while an assistant under his direction places others at intermediate points.

The Chain.—Short distances are measured with a rule; long distances with a chain. The chain is formed of links, or more properly of rods of large iron wire turned at the end into small loops and connected with each other by rings. The length of a link measured from centre to centre of the consecutive rings, is six inches. There are 100 links in a chain, so that a chain is fifty feet in length.† Each end of the chain has a handle which makes a part of its total length. For convenience in measuring distances less than a chain, there are brass markers at every ten feet.

The effort which is constantly made to stretch out the chain in useing it often increases its length. It is therefore necessary to submit it frequently to some test, such as applying it to the exact distance marked on a wall or floor, in order that the operator may be assured that the chain is of the proper length.

The operation of measuring is performed by two chain bearers, called *leader* and *follower*, and is commenced by placing poles in the direction to be measured. Departing from the first pole, the *follower* holds his handle on the ground at the point of departure *a*, (Fig. 1,) and the *leader* proceeds on the line in the direction of the second pole; taking out any kinks in the chain, and avoiding stones, tufts of grass, or any thing that may derange its right line direction. He then sticks a pin in the ground at the extreme point *d* of the chain. The pin is a piece of iron wire with a loop‡ at the end for the purpose of suspending it from the person by a hook. The pin being stuck, the chainbearers proceed, the *leader* dragging the chain until the *follower* ar-

* Small white flags, or flags of white, red and black, of different sizes and shapes, and variously combined, form good signals and are easily distinguished one from another.

† In the original work, this chain consists of 50 links of two decimetres each, or 100 decimetres. An addition of five millemetres (.19685 of an inch) is made in the length, (32.81 feet nearly) to compensate for the thickness of the ring, and the difficulty in stretching the chain.

The fifty feet chain is used in the United States for military, railroad and canal surveys, and the two and four pole chains for land surveying.

‡ This loop is also useful to attach small strips of white or red cloth, to guard against losing the pins in bushes, cane-brakes, high grass, &c.

rives at the pin, when he places his end of the chain against it, and the *leader* stretches the chain and fixes another pin, and so on to the end. The *follower* takes up each pin as he comes to it, and keeps it; the number he gets denoting the number of chains measured. If the distance exceeds ten chains, the *follower* on taking up the tenth pin, returns the whole ten to the *leader*, and records it in his book.* The distance of ten chains thus noted is called a tally. Every measurement should be taken parallel to the horizon. When the ground slopes, or there are impediments, the chain must be held horizontally above the ground. But as the chain swags from its own weight, this is impracticable, and the measurement is therefore not entirely exact.

Alidade.—This instrument is of various forms, but in describing one, all the rest will be easily understood. It is a movable rule which is directed towards different objects, whose relative position we wish to determine, taking the objects as points to sight upon. This rule (fig. 10) has at each end perpendicular limbs A B, C D, which can be removed at pleasure for the convenience of transportation. These limbs are called pinnules, or sights. A, is a very narrow vertical slit, to which the eye is applied, and opposite is a rectangular opening, in the middle of which, and perpendicular to the rule, is stretched a thread of silk or a horse hair. The plane passing through this thread and the slit opposite passes likewise along the edge I D, of the rule. As it is convenient to use the sight which is nearest, both are provided with a slit, and a rectangular opening and thread; the slit in one of them being placed below, and in the other above the rectangular opening.

To see a signal, turn the alidade in the direction of the object, so that the visual rays which pass through the slit and the thread shall coincide with the object. The plane of these visual rays is perpendicular to the plane of the rule, and should also coincide with its edge I D. To verify the fact, direct the instrument on an object, and draw a fine line along the edge of the rule; then turn the alidade, end for end, and, if in adjustment, its edge will coincide with the line drawn; should this not be the case, the thread must be moved until the error disappears.

Instruments used in measuring angles, which have arcs of circles, are similar in some respects to alidades; but they have a movement about a centre, (see what follows and fig. 22.)

8. When signals are too distant to be observed with the naked

* If eleven pins are used, which is a better number, the ten pins forming the tally are returned to the leader on the eleventh pin being stuck in the ground, and which then becomes the first pin in the next tally.

eye, a telescope is used in place of the simple sights. It contains two lenses, one towards the object, called the object-glass, and the other towards the eye, the eye-glass. The two glasses are placed at such a distance apart that their respective foci are nearly at the same point in the interior of the tube. In this focus, common to both, is a diaphragm, across which two threads are stretched at right angles to each other. This diaphragm is movable along the tube of the telescope, and can, by this means, be placed exactly in the common focus of the two glasses, (see 103.)

When the telescope is directed on an object, the signal should appear directly on the intersection of the hairs, or in coincidence with one of them. This telescope inverts objects, but no inconvenience results from this circumstance. It is mounted on a stand, above the alidade, and has a motion in a vertical plane.

9. *Vernier, Nonius.*—The fractional part of a division of an instrument divided into equal parts, is read by means of a small metallic plate, which moves in contact with the divisions, and is itself divided into equal parts. If the space occupied by $n-1$ of the principal divisions be divided into n parts on this plate, the nth part of the length of the principal division can be read by the aid of it. This contrivance is called a *vernier*, or *nonius*, after two geometricians, one of whom invented, and the other brought into general use, this valuable auxiliary to accuracy. The theory of the vernier is given in the following article.

H A I (fig. 11) is a fixed rule, divided into equal parts . . . 8, 9, 10 . . .; the small rule C D, which has a motion parallel to and along the first, is just the length, for example, of five of these parts, and is marked in six equal divisions, and numbered. Let us suppose the extremity C coincides with the 10th division. If we take one of the divisions of A B for a unit of measure, and compare the divisional lines of A B, and C D, we see that No. 1 of the small rule is higher than No. 11 of the large rule, by $\frac{1}{6}$ of the division assumed as unity; No. 2 is higher than No. 12 by $\frac{2}{6}$; No. 3 is higher than No. 13 by $\frac{3}{6}$; No. 4 higher than 14, by $\frac{4}{6}$; No. 5 higher than No. 15 by $\frac{5}{6}$; and lastly, that No. 6 is higher than No. 16 by $\frac{6}{6}$, or 1; that is to say, No. 6 corresponds exactly with the 15th division of the rule.

Now let the small rule C D, which is the vernier, be placed on the other side in the position C′ D′, and find the value of the fraction which is marked off at C′, or in other words, the length 13 *i*. To do this, see on the vernier and the rule what two divisional lines exactly coincide. In this instance No. 5 coincides with H, from which we conclude that the length 13 *i* is $\frac{5}{6}$ of a division of the rule H A, and that the point C′ reads 13 units and $\frac{5}{6}$ of a unit. For No. 4 is below 17, ;

No. 5 below $16\frac{2}{6}$, and so on to C′, which is below $13\frac{5}{6}$. The No. 5 on the vernier which designates the division in coincidence, indicates the numerator of the fraction $\frac{5}{6}$ without taking the trouble to count the parts one by one. The units are here divided into sixths, because five of these units are divided into six parts on the vernier. Figure 12 is constructed on the decimal principle, nine parts of the scale making 10 of the vernier A B. According to this, the line *i* reads 57 units and $\frac{6}{10}$; the fraction being ascertained by remarking that the divisional line, No. 6 on the vernier, is the only one which corresponds with any divisional line on the scale.

The same reasoning applies to the case of a circle divided into equal parts (fig. 9.) Suppose the arm A C with the vernier I F fixed to it, movable around the centre C of the graduated arc A D. This vernier is terminated by a concentric arc which moves in contact with the divisions on the limb in every position of the arm A C. An arc of nine degrees of the large limb, embraced between I and F, and divided into 10 equal parts on the vernier, will read tenths of a degree. If the vernier is placed so that the last divisional line corresponds with the zero point of the graduated limb, the divisions of the vernier, will be above the corresponding divisions of the limb respectively $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, &c.

If the vernier is placed in any other position, such as C B, we see that the zero point on it corresponds to 56 degrees and a fraction; this fraction expressed in tenths, is found, by observing that the sixth divisional line on the vernier is just on one of those of the arc; and hence the angle A B is 56° and 6 tenths.

In most instruments used to measure angles, the circle is divided into 360 degrees, and the vernier reads to minutes; the arc of the vernier being 59 degrees and divided into sixty equal parts. If the circle is divided into half degrees, the arc of the vernier is made 29 degrees and divided into 30 equal parts, and will give the thirtieth of a half degree, which is a minute. If we desire great precision in obtaining the parts of a minute, the circle and the vernier are divided into much smaller parts; but to do this, the instrument must be constructed with great care, and of large dimensions. If, for example, we wish to read to 5″, each degree of the limb is divided into twelve parts, each part occupying five minutes. Then take upon the vernier an arc of 59 of these parts and divide it into 60 equal parts, and the fraction will be $\frac{1}{60}$ of 5 minutes, or 5 seconds Repeating circles and theodolites are frequently divided with this minuteness; (see Nos. 92 and 105) but this precision is neither usual nor necessary in the ordinary surveying instruments.

Although the very small divisions of the limb and vernier of these

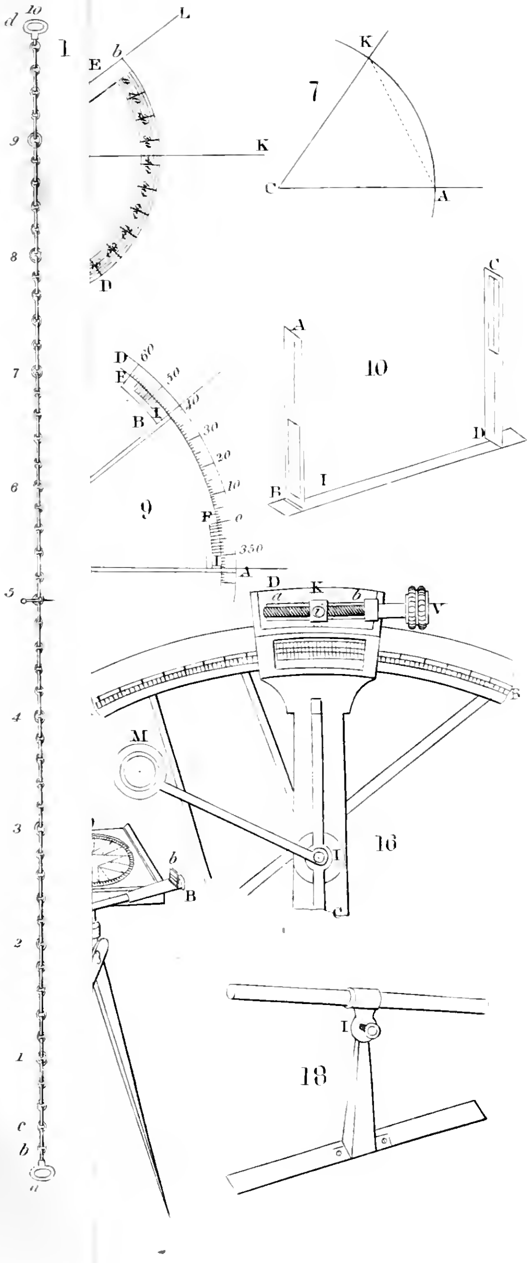
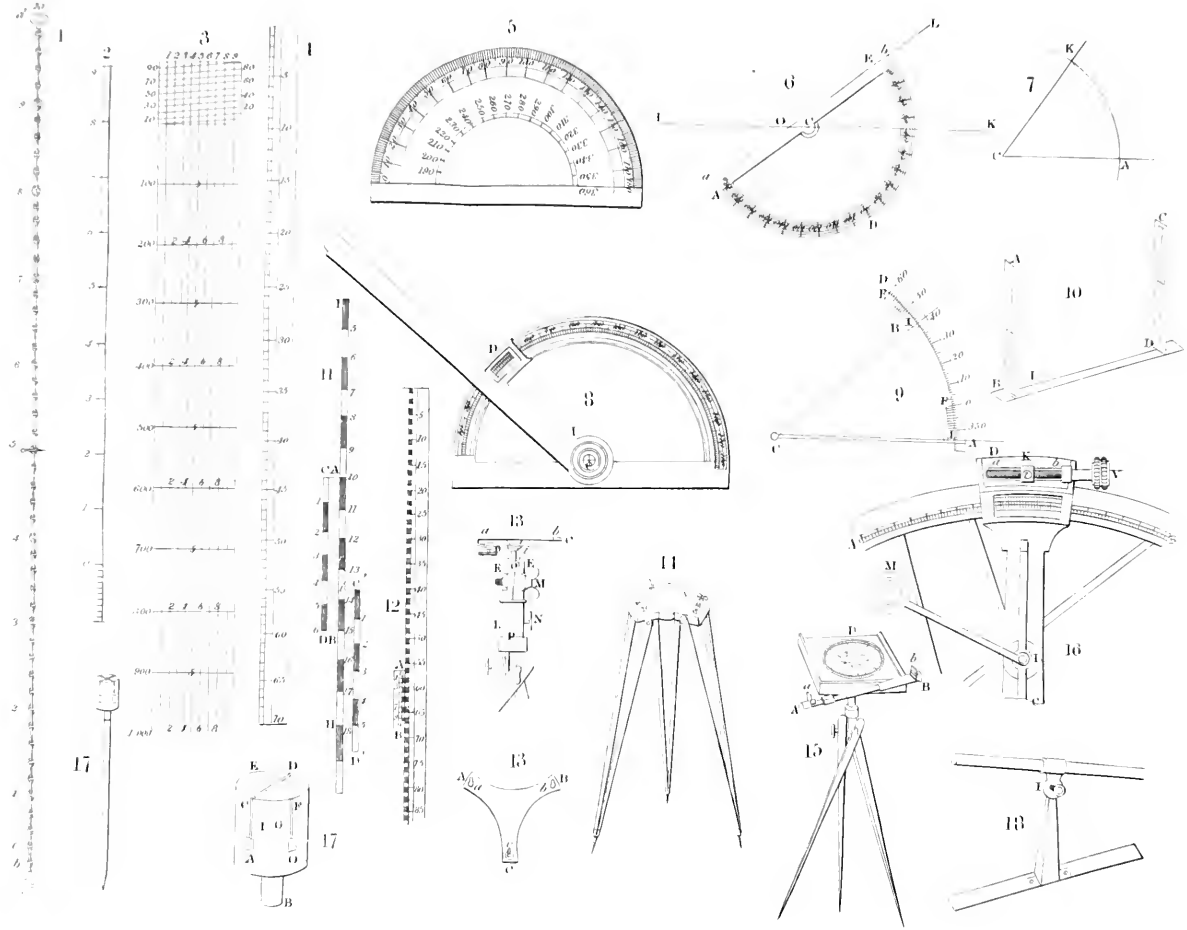

1
7
9
10
16
18

Plate I



instruments, can only be read by the aid of a magnifying glass, the art of constructing them is carried to such perfection by the aid of machinery, that the equality of the divisions may be entirely relied upon. As it would be difficult to count the number of divisions on the vernier from the zero point to the division of coincidence, they are numbered at regular intervals of five or ten parts; the number expressing the minutes, or seconds, &c., as the case may be, to be added to the number of degrees marked on the limb, at the point indicated by the zero of the vernier.

An instrument well centered and well adjusted, gives results with astonishing accuracy.

When the vernier and limb are graduated into small divisions, it is frequently difficult to determine at which of two consecutive lines of division the coincidence occurs. In this case, the mean between them is taken.

10. *The Tangent Screw.*—This is an invention designed to communicate very slight motion to a piece which has a motion along another piece which is stationary.

If, for example, we wish to direct the telescope of a graphometer upon a signal, it is first directed very near the object. This being done, the purpose of the tangent screw is to place the object and the crossing of the hairs in exact coincidence.

The difficulty which this problem presents, consists in making the telescope independent of the tangent screw in its large movements, while in the small movements it shall be regulated by it. The following is a description of the manner in which this is done.

A B (fig. 16) is the limb of a graphometer; C D the arm, or movable radius which carries the telescope; D, a part of the arm, is a slider and carries along with it the screw V, which turns in a socket *b*. In an opening *a b* of the slider is lodged a piece of metal susceptible of being moved along in the open space for a short distance. This piece being attached to the arm C D, and the telescope, by means of the screw V, which acts as a connecting rod, carries with it a female screw *i*, in which the screw V bites; so that when this piece of metal is clamped to the limb and the screw V turned, the slider or arm D advances or recedes, and communicates a slight movement to the telescope with which it is connected. Under this fixture is a clamp with two springs, and provided with a clamp screw K. These springs release or hold fast the limb according to the direction in which the clamp screw is turned.

To use the tangent screw, loosen the clamp, and turn the arm C D, which carries with it the vernier, the tangent screw and the telescope, until the telescope is turned very nearly on the signal; then clamp the

piece of metal which carries the female screw *i*, to the limb by turning the clamp screw K. This done, turn the tangent screw V in the socket *b*. As this screw bites in the female screw *i*, which becomes fixed by clamping, it moves in either direction the slider or arm D, and imparts to the telescope a very delicate motion, by which the cross hairs in the diaphragm can be made to coincide with the signal.

The socket *b*, and the female screw *i*, are mounted on pivots, that the axis of the screw may always remain perpendicular to the arm C D, and that the screw may move freely by a slight touch.

One entire turn of the tangent screw moves the slider or arm along the female screw only a distance equal to one spiral, measured on the axis of the screw. If this distance is half a millemetre [.01968 of an inch] and the screw is turned thirty degrees, that is one-twelfth of an entire revolution, the arm will be moved only one twenty-fourth of a millemetre, [.00164 of an inch.]

The arrangements of the tangent screw vary with the form of the instrument, but are always according to the principles explained above. The vernier, instead of being placed in a rectangular opening at the termination of the arm, as in fig. 16, is more frequently placed at the side of it, as in fig. 9.

A magnifying glass M is attached to the arm, and revolves with it, for the purpose of reading the graduations on the limb and the vernier. It is furnished with a hinge at I to enable the operator to place it at the proper distance from the graduation to suit his vision.

11. *The Tripod.*—The stand which supports surveying instruments is called a tripod. It consists of three legs which can be so opened or closed as to allow the instrument to retain a horizontal position notwithstanding the inequalities of the ground. The legs forming the tripod are joined together by being screwed to projections from a metallic plate called a staff-head, which supports also the socket of the instrument. These staff-heads, and the arrangements for screwing the legs to them, are of various kinds. When the legs are thus secured at the top, and spread out at the bottom, a stand is formed sufficiently stable. The extremities of the legs are shod with iron. When the instrument is to be transported, the legs are removed from the staff-head, laid together, and bound by a movable band of iron.

The legs being light, sometimes yield in using the instrument.* To obviate this and give additional stability to the instrument, the legs should be made in the shape of a V, as in fig. 14.

12. *The Universal Joint.*—It is necessary that an instrument be

* This inconvenience can only occur to the most unskilful operator. The force of the wind is a more probable cause.

so joined to the stand that a horizontal, vertical, or oblique position, according to the nature of the observation, may be given to the limb. This junction is by means of the universal joint which admits of any of these positions for the instrument. There are various kinds.

The Ball and Socket.—This is composed of a short rod *i*, fixed to the instrument and terminated by a brass ball O (fig. 13.) The brass cylinder L N, which has at bottom a cavity to receive the staff-head, is terminated at top by two shells E E; these are two distinct pieces, concave towards each other, one of which is permanently fixed to the cylinder L N, while the other being free, can be brought in contact with, and pressed against, the first by means of the clamp screw M. By loosening the clamp screw, the ball can be moved in every direction, and the limb made to take any position desired. When the limb is in the desired plane nearly, the screw M is slightly turned, the friction being sufficient to retain the ball, at the same time that it will allow enough motion to place the limb exactly in position. This being done, the screw M is tightly clamped.

13. *Cugnot's Joint,* (fig. 19,) is composed of a nut N, formed of two cylinders whose axes are placed at right angles and one a little above the other. The bolts B' B', and B run in the direction of the axes, and are screw-tapped at one end to receive nuts.

When the joint is attached to the tongues L L, which carry the table of the instrument, we can by loosening the nut, move the table in two directions, perpendicular to each other, and consequently adjust it to a horizontal position. By tightening the nuts all motion ceases, and the table remains fixed in the given position. The movements given to the table by this means are precisely similar to those of *Cardan's suspension,* used in the mariner's compass and in chronometers, to preserve a horizontal position on board of vessels. Cugnot's joint is very frequently used in the plane table, an instrument which we shall notice hereafter.

14. *The Road or Slope Level Joint.*—This is a simple hinge which gives a vertical motion to a spirit level, and enables the operator to bring the bulb in the middle. As its motion is very abrupt, it cannot be used with any degree of accuracy without the aid of a tangent screw.

To be continued.

Statement of the performance of the Locomotive Engine, "Hichens & Harrison," built by Messrs. Baldwin, Vail & Hufty, for the Philadelphia and Reading Rail Road.

On February 9, 1841, the above engine hauled over the Philadelphia and Reading railroad, 54½ miles in length, from Reading to its

intersection with the Columbia railroad, a train of *one hundred and five* loaded burden cars, laden with 1318 barrels of flour, 870 kegs nails and spikes, 635 bushels grain, sixty-three tons of blooms and bar iron, twenty cords wood, eight casks oil, and sundry other articles of freight, amounting, in all, to 308½ tons of 2240 lbs.

Weight of the 105 cars, 173 tons, making a total gross weight of 481½ tons of 2240 lbs., equal to *one million seventy-eight thousand five hundred and sixty pounds,* hauled by the engine, not including her own, or her tender's weight.

Cars all four wheeled, wheels three feet diameter, lard and tallow only used in boxes. Whole length of train, 1260 feet, (or sixty feet less than one-fourth of a mile.) Running time, four hours fifty-four minutes, making an average speed of $11\frac{1}{10}$ miles per hour.

Total quantity of fuel consumed, 2.51 cords of oak wood.

Total quantity of water evaporated, 1804 gallons.

Oil used by engine and tender, seven quarts, including oiling before starting; longest continuous level over which the above train was hauled, $9\frac{1}{10}$ miles. Her speed, with the train on this level, $10\frac{9}{10}$ miles per hour.

Weight of engine, empty, 23,250 lbs. With water and fuel, 26,710 lbs. Weight on driving wheels, with water, fuel, and two men, 14,120 lbs. Cylinders, 12½ by 16 inches stroke; driving wheels, four feet diameter.

The above road has no *ascending* grade, from Reading *towards* Philadelphia, with the exception of half a mile, at its lower terminus, or intersection with the Columbia railroad, graded at 26½ feet per mile, on which grade the train was stopped.

The profile of the road, from Reading to this point, is divided into levels, varying from 1600 feet to $9\frac{1}{10}$ miles in length, and *descending* grades of from one and a half to nineteen feet per mile, the latter being the heaviest grade on the road.

Total length of level line between above points, $27\frac{8}{10}$ miles.

Total fall, from where the train was started to where it was stopped, near the Columbia rail road, 214 feet.

Shortest radius of curvature on the road, 819 feet; 1480 feet of curve struck with this radius.

The engine started the above train on a level, without any assistance, and gradually increased her speed to the average rate above mentioned.

She worked with great ease to herself during the whole trip; and hauled the train for the last fourteen miles, ten of which were level, over rails in very bad order, owing to a light snow storm, which moistened without wetting their surface; the effects of which, in di-

minishing the adhesion and power of the engine, practical engineers can well understand and appreciate.

The above performance is believed to be unsurpassed; and the train to be the longest and heaviest ever hauled by *one* engine on any railroad in Great Britain or America.

G. A. Nicolls,
Superintendent Trans. Phila. and Reading R. R.
Reading, Pa., Feb. 10th, 1841.

Second Report of the Directors of the New York and Erie Railroad Company, to the Stockholders. February 3rd, 1841.

[continued from page 265.]

Appendix.—Note A.

To E. Lord, Esq., President, &c.

Sir—The subjoined statistical tables, having a bearing on matter connected with the great work of internal improvements, in which you are engaged, I have prepared with much care, and respectfully submit the same for the consideration of the stockholders of your company, and the public. Your obedient servant,

Edwin Williams,
Compiler of the New York Annual Register.
New York, February 3rd, 1841.

1. *Annual consumption of country produce in the city of New York.*

The following is an approximate estimate of the annual amount of sales of articles of country produce, in the city of New York, for the consumption of the inhabitants.

Fresh Beef,	$ 1,470,000
" Veal,	365,000
" Mutton and Lamb,	335,000
" Pork,	600,000
" Poultry, Game, Eggs, &c.,	1,000,000
Salted Beef, Pork, and Hams,	1,200,000
Vegetables and Fruit,	1,200,000
Milk,	1,000,000
Butter, Cheese, and Lard,	1,500,000
Flour, Meal, and other Bread Stuffs,	3,000,000
Hay and Oats,	750,000
Fuel, (Wood and Coal) exclusive of Steamboat Fuel,	2,500,000
Articles not enumerated,	580,000
	$ 15,500,000

The above is not intended to include building materials.

The opening of a new avenue for supplying our markets, such as the New York and Erie railroad, which passes through a section of country well adapted to the furnishing of most of the above articles, would doubtless have the effect of reducing prices by increasing the abundance of supplies. This reduction may be safely estimated to

average ten per cent. on the above amount, thus saving, annually, to the inhabitants of this city, a million and a half of dollars.

2. *Increase of population, &c., in the Railroad Counties.*

Increase of population and wealth in the counties traversed by the New York and Erie railroad, and of adjacent counties and parts of counties in this State, as shown by the census of 1830 and 1840, and the taxed valuation of real and personal estate in the same years:—

Counties traversed.	*Census.*	*Census.*	*Value of real and personal estate.*	
	1830.	1840.	1830.	1840.
Rockland,	9,388	11,874	$ 1,696,790	$ 2,229,469
Three-fourths of Orange,	34,029	38,050	6,325,777	8,656,670
Sullivan,	12,372	15,630	1,215,750	1,319,586
Three-fourths of Delaware,	24,700	26,522	2,315,555	2,544,060
Broome,	17,582	22,348	1,785,168	2,361,737
Tioga,	27,704 (Tioga and Chemung)	20,350	2,398,002 (Tioga and Chemung)	1,906,747
Chemung,		20,731		3,015,592
Steuben,	33,975	45,992	1,476,340	5,787,282
Alleghany,	26,218	40,920	1,260,442	5,216,000
Cattaraugus,	16,726	28,803	1,249,018	4,149,073
Chatauque,	34,657	47,641	1,851,353	4,360,179
Counties Adjacent.				
Two-thirds of Oswego,	34,248	32,942	3,588,730	3,879,397
Chenango,	37,404	40,779	3,481,314	4,293,438
Cortland,	23,693	24,605	2,169,119	2,320,720
Tompkins,	36,545	38,113	2,726,596	4,360,673
One-third of Cayuga,	15,982	16,787	1,384,711	4,170,885
One-third of Seneca,	7,010	8,289	1,008,043	1,726,318
One-half of Yates,	9,504	10,221	1,020,348	3,231,091
One-fourth of Ontario,	10,042	10,875	1,945,088	3,464,312
One-half of Livingston,	13,859	17,855	1,712,366	5,072,979
One-half of Genesee,	25,996	29,820	2,149,297	6,462,772
One-fourth of Erie,	8,928	15,538	724,781	3,471,378
	460,562	564,685	43,484,588	84,000,358
		460,562		43,484,588
Increase in ten years,		104,123		$ 40,515,770

3. TABLES SHOWING THE EFFECT OF INTERNAL IMPROVEMENTS ON THE VALUE OF PROPERTY IN THE CITY OF NEW YORK.

1. *Chronological Table of the Assessed Value of Real and Personal Estate in the city of New York, during three Commercial Periods.*

1*st Period*—From the close of the last war with Great Britain to the completion of the Erie canal:

Year.	*Assessed Valuation.*	*Year.*	*Assessed Valuation.*
1815,	$ 81,636,042	1820,	$ 69,539,753
1816,	82,074,200	1821,	68,285,070
1817,	78,895,735	1822,	71,289,144
1818,	80,245,091	1823,	70,940,820
1819,	79,113,061	1824,	83,075,676

2d Period—From the opening of the Erie canal, in 1825, to the completion of the Ohio canal:

1825,	$ 101,160,046	1829,	$ 112,526,016
1826,	107,477,781	1830,	125,288,518
1827,	112,211,926	1831,	139,280,214
1828,	114,019,533	1832,	146,302,618

3d Period—From the completion of the Ohio canal, in 1832, to the present time:

1833,	$ 166,495,187	1837,	$ 263,747,350
1834,	186,548,511	1838,	264,152,941
1835,	218,723,703	1839,	266,882,430
1836,	309,500,920	1840,	252,135,515

N. B. During the latter period, namely, since 1832, about 470 miles of railroad have been completed and put in operation in this State, besides about 2,500 miles of railroads in other States. Thus it will appear that since the introduction of the *railroad system*, the value of real and personal property in the city of New York has increased over *one hundred millions of dollars.*

The amount of tonnage of canal boats passing and repassing Utica, on the Erie canal, for one year, it is ascertained, is greater than that of all the foreign and domestic shipping entering and clearing at the port of New York. (*See R. R. J. Vol.* 4, *No.* 1.)

2. *Chronological Table of the Assessed Value of Real Estate only, in the city of New York, for a series of years:*

Year.	*Real Estate.*
1817,	$ 57,799,435
1820,	52,062,858
1823,	50,184,229
1825,	58,425,395
1828,	77,139,880
1831,	95,716,485
1833,	114,124,566
1834,	123,249,280
1836,	233,742,303
1839,	196,940,134
1840,	187,121,714

Increase of value of real estate in this city, since 1831, over ninety-one millions of dollars.

Assessed value of personal estate in 1840,	$ 65,013,801
" " " 1833,	52,366,976
Increase,	$ 12,646,825

Extract from a report to the stockholders of the Camden and Amboy Railroad Company, dated January 29th, 1840:—

"Two years since, at the request of some market people in New Jersey, a line called the Pea Line, with two cars, was occasionally started from Camden to New York, with no other view or expectation than the accommodation of a very useful and respectable class of men. This line has steadily increased, until it has become profitable beyond all expectation. During the past year, it has been running daily, sometimes taking with it as many as sixteen cars, laden at the appropriate season, with peas, peaches, potatoes, asparagus, cabbages, live stock; and upon one occasion, (incredible as it may seem) thirty tons of green corn. This, connected with the gradual increase on the other lines, will enable you to judge what you may fairly expect in a few years hence; always bearing in mind, that the expenses do not increase in the same ratio with the receipts, because the same capital can do a larger business, whilst the interest to be paid remains the same."

(Note B.)—Dunkirk Harbour.

Extract from the documents accompanying the President's Message to Congress, of December, 1837.

"The importance of the harbour of Dunkirk, in a commercial point of view, has heretofore been fully set forth. The surface enclosed by the government works, will be about two hundred and eighty acres, of which there are eighty acres of excellent anchorage, with clay bottom; and there is wharf room sufficient for the transaction of a very large business. It occupies a position nearly midway between Buffalo and Erie. It is extremely valuable as a port of refuge, and has been much resorted to for that purpose by steamboats and sail vessels; and it has been selected for the termination of the New York and Erie railroad through the southern tier of counties of the State of New York; a work, the completion of which will at once place it among the chief harbours on the shores of lake Erie. The number of steamboats and sail vessels touching at this port has, during the past season, greatly increased. From the opening of the navigation, on the 5th May, to the 30th September, 1837, the number of arrivals of steamboats was 630, whose probable tonnage amounted to 183,177 tons, and the number of passengers to 78,700. During the same period, the number of arrivals of sloops and schooners was 103. Shipping to the amount of 778 tons is owned at the port."

The above is taken from the annual report of T. S. Brown, *General Superintendent of the United States works at the east end of lake Erie.*

The distance from Dunkirk to Piermont, on the Hudson river, by the line of the New York and Erie railroad, is 446 miles. Including the *ferry,* the whole distance to New York city does not exceed 468 miles.

From Buffalo, by the way of Albany, to New York, the distance by railroad will be about the same, viz:—

Buffalo and Batavia railroad, (via Attica,)	-	39 miles.
Batavia and Rochester "	- - - - -	32 "
Rochester and Auburn "	- - -	78 "
Auburn and Syracuse "	- - - - -	26 "
Syracuse and Utica "	- - -	54 "
Utica and Schenectady "	- - - - -	78 "
Schenectady and Albany "	- - -	16 "
Albany and New York "	- - - - -	149 "
Total,	- - - - -	472 miles.

Dunkirk is forty-two miles west of Buffalo, on the south shore of lake Erie, and its harbour is occasionally open many days, and even weeks, earlier in the spring and later in the fall.

The line of the New York and Erie railroad being entirely in the hands of one company, the principle of charging less per mile in proportion as the distance traveled is greater, may be brought into action, and will, doubtless, result in great advantage both to the public and to the company. Passengers from Dunkirk to New York city, for instance, may be charged twelve dollars, which will be about two and a half cents per mile; whereas, way passengers traveling 100 miles or less, may be charged four cents per mile. As the superstructure will be heavy and substantial, passengers by quick trains may with certainty and safety go from Dunkirk to New York in from twenty to twenty-four hours, or at the average speed of twenty miles an hour, including stops.

If we compare this with the state of things at present existing on the northern line, and which will probably continue for a considerable time to come, we shall see that there, in consequence of there being eight different corporations, each of which, until compelled by some strong inducement to the contrary, will charge the full rate of four cents per mile, the price of the passage from Buffalo to New York will be from seventeen to nineteen dollars,—the former sum allowing for a deduction by the competition of the North river steamboats. As the track on the northern line consists of the light plate bar, the speed cannot exceed fifteen miles per hour; and the time occupied, including the unavoidable detentions resulting from so many different proprietorships, the ferry at Albany, etc., cannot be less than thirty-six hours. The New York and Erie railroad, therefore, at the first commencement of its operations, may very well be able to offer to passengers from lake Erie and the western States, the inducement of a saving of $5 in expense, and twelve hours in time.

The following statements, which exhibit in a very striking manner the rapid increase of the trade of the upper lakes, are extracted from a late report of Lieut. Col. Kearney, *of the United States Topographical Engineers.*

"In the year 1825, there was but one steamboat, of 350 tons bur-

den, and thirty or forty small craft on the American side of the upper lakes, and the tonnage was, in all, somewhere about 2,500 tons. In the year 1830, the registered and enrolled tonnage was yet but 3,497 tons, and the canals which connect the trade with the St. Lawrence and with the Hudson, had been completed.

"In 1831, when the works on lake Erie had begun to afford some protection to vessels, the tonnage employed upon it had nearly doubled that of the preceding year. There were now eleven steamboats and one hundred other vessels, the aggregate tonnage of all amounting to 6,532 tons.

"In 1832, the Ohio canal, connecting the lake trade with the valley of the Mississippi, was completed. The aggregate licensed and enrolled tonnage, according to the treasury statements, (we have no other account of the shipping for that year,) was 8,552 tons. During this and the succeeding year, the harbours, as already stated, were becoming at all times accessible to the largest class of vessels, and in the latter year (1833) this accessibility was effected. In that year the aggregate tonnage was 10,471 tons. Since that time it has continued to be steadily progressive to the present period. We have more precise accounts of it for the years 1836, 1837, 1838 and 1839, and we insert here the aggregate tonnage for these four years, distinguishing between that of steamboats and rigged vessels:—

"In 1836, there were 45 steamboats, (9,017 tons,) and 211 vessels, (15,030 tons) in all, 24,047 tons.

In 1837, there were 50 steamboats, (10,509 tons,) and 230 vessels, (16,934 tons,) in all, 27,443 tons.

"In 1838, there were 52 steamboats, (17,429 tons,) and 234 vessels, (16,848 tons,) in all, 34,277 tons.

"In 1839, there were 61 steamboats, (17,324 tons,) and 225 vessels, (17,799 tons,) in all, 35,123 tons.

"The value of the shipping of all classes in the year 1839, is $2,400,600, and they furnish employment for two or three thousand persons. In the year 1836, it was estimated that the capital invested in steamboats was $1,000,000. In the year 1839, the cost of steamboats is estimated at $1,741,200. In the year 1837, it was estimated that, taking into view the average number of trips made by each class of vessels, the trade per month, during the business season, amounted to 75,898 tons. Following this rule, and applying it to the year 1839, we would have about one hundred thousand tons as the monthly business."

(Note C.) *Description of the manner in which it is proposed to construct the track of the New York and Erie railroad, on those portions not already laid. The part between Goshen and Piermont has been made on the same principles, with some modification of the details.*

The iron rails are of the H form, with heavy heads. They are three and a half inches high, four inches wide on the base, and weigh fifty-six pounds per lineal yard. Both sides are alike, in order to ad-

mit of reversion, if symptoms of failure are perceived in those parts exposed to the action of the wheels.

The rails are to be supported on continuous bearings of timber, twelve inches broad, eight inches thick, and as long as can be conveniently obtained. They must be scarphed at the ends, so that no irregular elevation or depression of either stick can take place at a joint. They will break joints with each other, and with the iron rails; and will be bound together, at every six feet on curves, and at every eight feet on tangents, by cross ties of plank, seven and a half feet long, three inches thick, and seven inches wide, fitted accurately into notches two and a half inches deep, on the upper side of the longitudinal timbers, and secured by a treenail, or pin of oak, two inches in diameter. The position of the base of the rail having been then accurately marked out on the cross ties, notches half an inch deep and four inches wide will be cut in them, so as to let the rail rest continuously on the longitudinal timbers, the edges of which must be addiced down to shed the rain.

The rails are secured from any motion, except that due to the expansion and contraction of the metal, by appropriate chairs of cast iron at the joints; and are fastened to the timbers by brad headed spikes, half an inch square and five and a half inches long, one of which is required for every eighteen inches.

Where timber of suitable quality is found on the line of the road, it may be hewn on two sides instead of being sawed square. In such cases it must be got out nine inches thick, and counter hewn on the upper surface before being laid.

It will be noticed that by this plan of road, each bearing timber rests continuously on the ground, and at the same time supports continuously the iron rail. The cross ties too, have a double action; binding together the longitudinal bearers, and also connecting the rails, by the notches into which their bases are fitted. By placing the ties on the upper side of the bearers instead of the lower, the connexion is made at the point where its efficiency is greatest and most necessary, and as no part of the vertical support is derived from the ties, the dimensions proposed for them will be found sufficient.

The drainage of the track will be effected by a ditch between the longitudinal timbers, for which the width between the rails affords ample room; and cross drains at suitable distances will carry off the water. The centre drain, will be sunk lower than the cross ties, so as not to interfere with them.

The following extract from an English writer, Mr. John Reynolds, explains very satisfactorily the disadvantages of the ordinary modes of constructing railways, and accounts, in some measure, for the great weight which the latest patterns of British rails exhibit.

"The principle of continuous bearings, avoids the chief obstacle to durability, which pertains to the plan of supports at intervals, whether they be blocks or sleepers, viz. the alternation of *flexible spaces* and *rigid points*, which, (even if the supports maintain an exact level,) produces in carriages moving rapidly over them, a series of concussions, as the wheels successively impinge on the rigid or sup-

ported parts of the rails. Also, however small may be the deflexion of the rail between its points of support, those points become fulcra, on which it acts as a lever, to raise or shake the supports next beyond them. When the supports assume irregular heights, (which is the usual case,) not only are the above evils greatly aggravated, but the rail acts upon every support as a spring beam, tending to jerk it up, or loosen its fastenings."

Where a *piled road* is adopted, (which will be the case on more than two hundred miles of the Susquehanna and Western Divisions,) a similar superstructure is proposed, with the necessary modifications for connecting it firmly and securely to the heads of the piles.

The *width of track* on the New York and Erie rail road is six feet, and the distance between the tracks (where two lines are laid,) is seven feet. These dimensions admit of wider and more commodious cars being used with safety, than can be adopted for roads of the ordinary width. The first class passenger cars already built for this road, are believed to be equal to any hitherto constructed in the United States, with regard to beauty and finish, and superior in all the arrangements and appliances requisite for comfort and ease. They are eleven feet wide, and thirty-six feet long, and are mounted on eight wheels. Those intended for gentlemen, will accommodate, comfortably, seventy-eight persons. The ladies' cars have drawing and retiring rooms of ample dimensions.

The second class cars, intended for the use of emigrants, and others desirous of traveling at a low rate, and willing to accept of cheaper accommodations, will be capable of carrying one hundred persons.

[TO BE CONTINUED.]

Bibliographical Notice.

Notice of a description and catalogue of the Derby Arboretum. By J. C. LOUDEN, F. L. S., &c. &c.

A garden comprising eleven acres of ground, beautifully laid out and embellished with upwards of a thousand different varieties of plants and trees, has lately been presented to the inhabitants of Derby, England, by one of their citizens, Joseph Strutt, Esq., as a place for public recreation. The admirable design of this garden, both for physical and intellectual enjoyment, as well as for general improvement in the interesting science of botany, is worthy of particular remark, and may afford useful hints in the laying out of Public Grounds in any country.

It consists of a collection of such trees and shrubs, foreign and indigenous as will endure the open air in the climate of Derby, with the names placed on each.—The author of the plan, J. C. Louden, Esq., observes, in reference to it, "that such a collection has all the beauties of a pleasure ground viewed as a whole; and yet, from no tree or

shrub occurring twice in the whole collection, and from the name of every tree and shrub being placed against it, an inducement is held out for those who walk in the garden to take an interest in the name and history of each species, its uses in this country and in other countries, its appearances at different seasons of the year, and the various associations connected with it."

In order to excite an interest in the subject, visitors are supplied with printed catalogues containing the names of the plants, their habits, native localities, &c. "The order in which they are arranged," continues Mr. Louden, "is what is called the *natural method*, by which plants are classed or grouped according to the greatest number of points in which they resemble one another. The largest groups form classes, the next largest orders, and these are subdivided into tribes, genera, species, and varieties. This mode of bringing plants together in groups greatly assists, not only the memory, but the judgment; for, if we recollect any one plant in a group, and its properties, we may conclude that all the others belonging to it bear the same general resemblance externally, and contain, more or less, the same internal properties. This any visiter of the garden may convince himself of by looking at all the plants enumerated under any one order, and comparing them with one another; and this he may do at any season of the year, though to the greatest advantage when the plant is in flower."

The gravel walks in the garden measure upwards of a mile in length and are ornamented with pedestals, vases, seats for three hundred and fifty persons, beautiful pavilions in the style of James the first, and lodges in the Tudor and Elizabethan style.

The plan of the Arboretum emanated from the highly cultivated mind of Mr. Louden, its execution was attended to by him in person, assisted by Mr. Rauch, and the architectural designs for the pavilions and lodges are by Mr. Lamb, of London. The best talent of the country has thus been brought into requisition by Mr. Strutt to give value and elegance to his gift.

Instances of *living* munificence on so grand a scale as this are seldom to be found. Men frequently *leave* their accumulations of wealth to public objects, and give, for noble purposes, treasures they can no longer enjoy nor take with them; but however praiseworthy such posthumous generosity may be, it bears no comparison with the liberality of the man who shares his fortune with a whole community during his life-time, and thus deprives himself of what he might probably live long to enjoy.

A pamphlet containing a description of the Arboretum, a catalogue of the trees and plants, and an account of the ceremonies of opening

it to the public, has been received from the author, and is placed in the Library of the Institute. T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1840.
With Remarks and Exemplifications by the Editor.

1. For an improved machine for *Pressing Palm-leaf Hats;* Chester Gorham, Barre, Massachusetts, March 3.

In this machine the hat to be pressed is placed on a block attached to the upper end of a vertical shaft, the lower gudgeon, or pivot, of which rests on a sliding step provided with a weighted lever for the purpose of forcing the crown and rim of the hat against the irons. The irons, or, as they are termed, "boxes," in which the heaters are placed, are attached to a sliding frame provided with a lever to enable the operator to apply them to the hat and draw them off. One of the "boxes" is attached to each side of the frame for the rim, a third is attached by gudgeons to the back, for the crown, and the fourth slides in a vertical frame rising from the first mentioned frame, to press the top of the crown, and is furnished with a screw to regulate its distance from those that press the rim. The weighted lever is provided with a catch to relieve the pressure. The claim is confined to the combination of the boxes that press the rim and crown attached to the first mentioned frame, the box that presses the top of the crown regulated by a screw, and the shaft to which the hat block is attached. Some practical difficulties present themselves in the carrying out of the alleged improvements, as for instance, the irons which press the rim are both attached unyieldingly to the sliding frame, hence they cannot accommodate themselves to the inequalities of the hat—so of the pressure applied to the top of the crown, the distance between the top and the two rim irons, is regulated by a screw, which when set will not yield to inequalities. These difficulties do not exist in the machine previously known, in which the irons are attached by a universal joint to a lever, and the pressure applied to the hat by the operator's hands.

2. For an improvement in the manner of constructing *Bedsteads;* John Hart, Lebanon, Kentucky, March 3.

This improvement consists simply in extending the shoulder of the rail, which fits against the post, considerably beyond the periphery of the rail so as to render the posts more steady. "What I claim as my invention and desire to secure by letters patent, is the extension of the shoulder beyond the periphery of the rail in the manner and for the purpose specified."

3. For improvements in *Fire Escapes;* Sylvester Pentfield, Hartford, Connecticut, March 3.

This fire escape consists of a vertical shaft, rising from a pedestal of peculiar construction, on which slides a platform which can be moved up and down by the persons on it by means of a pinion mashing into a rack on the shaft. The platform is provided with a railing except on the side to be presented to the fire where it is provided with polished plates of metal which slide in grooves, to serve as a protection against the flames. The pedestal is formed of four bars called "arms," each of which is jointed to the lower end of the shaft, thus forming a cross. There are four diagonal braces hinged or jointed to the shaft, the lower end united to the outer end of the "arms," by attaching the end of each brace to a "block," which slides in a "mortice in each arm," and regulated by a screw. It will thus be seen that the shaft can be maintained in a vertical position without reference to the inequalities of the ground. The outer end of each arm is provided with a truck roller to facilitate the moving of the machine.

The claims are, "1st, combining with the movable platform, plates of polished metal, or of wood and metal combined, the said plates sliding in grooves at the back of the platform. And 2nd, the mode of keeping the shaft in a vertical position, so as to adapt it to any inequality of soil by means of the following combined arrangements, viz. the arms hinged to the shaft so as to admit of their being raised or lowered, in combination with the braces attached to the block moving in a mortise in the aforesaid arms, and regulated by means of a screw."

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4. For an improvement in *Dry Docks;* Charles F. Johnson, Tioga, New York, March 6.

This dock operates on the principle of those which raise the vessel by having inverted boxes under the cradle, into which air is introduced to exclude the water, and the patent is granted for a mode of preserving the equilibrium of the cradle and prevent rocking, which is effected either by means of vertical screws attached to each side of the cradle and passing through nuts on each side of the dock, or by racks with ratchets into which palls work, or by ropes passing around pullies attached to the sides of the cradle and dock.

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5. For an improvement in the *Door Latch;* Benjamin M. Bosworth, Warren, Rhode Island, March 6.

This improvement consists in the manner of working the latch by means of a rod of iron which passes through a vertical slot in the door, and which is provided with a knob on each side; when the rod is lifted up, it comes in contact with the inner end of the latch, which it lifts, and thus depresses the outer end, and disengages it from the hasp —the latch being the reverse of the common latch in its operation. The claim is confined to the mode of disengaging the latch by raising the rod and knobs vertically in the slot.

6. For an improvement in the *Knob Latch* for doors, &c.; Lewis and Willis Hotchkiss, Derby, Connecticut, March 6.

This improvement is applicable to the lifting and to the sliding latch, and consists simply in dispensing with the "lever," or "cam," usually employed on the bar to give motion to the latch, and effecting the same thing by cutting a notch in that part of the bar which comes in contact with the lever little less than one-half of its diameter, leaving a flat face which forms the cam. The amount of motion to be given to the latch will depend upon the diameter of the bar and the depth of the notch, which should not be more than the semi-diameter of the bar. The claim is confined to this device.

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7. For an improvement in the machine for *Mixing and conveying Clay for Making Bricks;* James Hodge, Fairplay, South Carolina, March 6.

A large threaded screw revolves in a trough for the purpose of mixing and conveying the clay to the moulding machine. At one end of the trunk there is a hopper in which work two pounders by means of tappets on a shaft, for the purpose of breaking the large lumps of clay, and forcing it into the threads of the screw, and at the opposite end of the trunk the clay is discharged into the moulds and pressed. The claim is confined to the pounders, or rams, in combination with the screw for mixing and conveying clay.

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8. For a *Machine for Colouring Maps, Charts, or other Prints;* Lucius Stebbins, Hartford, Connecticut, March 12.

The map or print is attached to a table so that it shall not move during the operation of colouring. A plate revolves upon a pin, or axis, attached to the same table, and to its outer edge are secured, in succession, a series of thin metal plates with holes through them corresponding with the boundaries of countries, &c., which are to be differently coloured. These plates are in succession applied to the surface of the map, &c., and the colour applied as in the process of painting with theorems. The patentee says, "I do not claim the invention of colouring through patterns or theorems as they are sometimes called; but I do claim as my invention and desire to secure by letters patent, attaching the patterns to a plate revolving on a fixed centre, as herein set forth, and the combination of the revolving plate with the table on which the map is placed, the whole constructed and operating as above described."

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9. For an improvement in *Trusses for Hernia, &c.;* Enoch Thomas, New Athens, Ohio, March 12.

This truss consists of an elastic belt passing around the body, to which the hernial, sacrum, and ilium pads are attached. From the sacrum pad two straps descend to the perineal pad, and from it the round straps pass and are connected to the front or hernial pads. Two pads, called femoral pads, one of which is straped around each

thigh, and connected to the belt by means of two straps attached to each and buckled on to the ilium and front pads. The patentee says, "this new and useful improvement is especially designed and perfectly adopted to cases of inguinal hernia, either in the male or female, and is so constructed as to prevent, during its application, any protrusion of the intestines through the inguinal ring. It is also perfectly adopted to cases of prolapsus uteri in females. What I claim in the elastic and spring supporter as my invention, is the simple combination of the thigh straps for retaining the belt in situ with the belt, constructed and operating as above described."

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10. For an improved mode of *Constructing Cars for Railroads and guiding them thereon;* Isaac Newton Stanley, Philadelphia, Pennsylvania, March 12.

It would be useless to attempt to give, without drawings, more than a general idea of the construction of the cars by which they are made to follow the curvature of the road and to run in and out without the aid of switches or any attendance. The improved construction is adapted to the eight wheeled cars now in general use, but instead of having the two axles of each truck in one frame, each axle is in a separate frame, and two of these frames are united together to constitute a truck, so that each axle can be thrown into the radii of the curvature, and the two trucks are so connected that when the axles in one truck assume the direction of the radii, those in the other truck are compelled to do the same. Instead of placing the outer rail of a curve upon a higher level than the inner one, to prevent the centrifugal force from throwing off the cars, this object is attained by a contrivance which gives to the body of the car an inclination inwards the moment the first truck runs upon a curve and assumes the line of the radii.

A guide rail is employed to prevent the cars from running off the track in short curves, and to compel them to follow any given track by having a roller connected with the car, and acted upon by the guide rail in a manner which could not be clearly explained without drawings. The patentee concludes by saying "I claim the manner in which I construct and combine the two four wheeled trucks as above set forth, by which the axles are made simultaneously to conform themselves to the radii of the curvature of the track; that is to say, the manner in which I connect the parts which I have denominated the hounds, with the respective frames of the trucks, and with the general frame or car bed, so that the two studs, or slides, which work in the slotted metallic plates, and the two transoms, or king bolts, always standing in a right line shall compel the respective angles to conform themselves to the curvature of the road by an arrangement of parts substantially as above set forth. I claim the manner of causing the load to incline over towards the inner rail of a curve by means of the projections below the bolster operated upon by the hounds, or by any analogous arrangement, as described. I claim the manner of compelling the locomotive or carriage to keep the proper

track by the aid of guard or guide rails constructed and located as herein described, and operating upon a guard or guide apparatus substantially with that herein made known, for the purpose of dispensing with switches and other analogous devices, and rendering the passing of the train, upon the proper track, independent of the engineer or conductor thereof. I also claim the use of the guard rail and guard apparatus for preventing the running of the carriage from the track, as described."

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11. For an improvement in the *Anvil for Heading Spikes;* Wm. Thomas, Hingham, Massachusetts, March 14.

A square hole is made vertically into the anvil for the reception of a block and tube of steel, the former resting upon the bottom of the hole in the anvil and the latter upon it. The hole in the tube is to receive the spike to be headed, and at the bottom there is a lateral groove which communicates with a groove running along the side of the block from top to bottom, for the purpose of discharging the oxides formed through a lateral opening in the side of the anvil. The usual heading tool is used. The claim is to "the making of an anvil with the openings at the top and side to receive the block and tube and for the escape of the oxides."

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12. For a mode of *Laying Veneers;* Casper Kittenger, Massilon, Ohio, March 14.

A board of any given length and width, to be governed by the size of the article to be veneered, passes through mortices made in two pieces of hard wood, one placed at each end. A mortice or slot is made in each of these pieces of wood, parallel with the one through which the board passes, to receive two rods of iron having a screw and nut on each end, to prevent them from falling out of the slot, but not screwed tight enough to prevent them from sliding along the length of the slots. To these rods is attached a band or sheet of iron, leather or cloth, reaching nearly the whole length, and hanging loose from one to the other, so as to form about a half cylinder. The board is provided with any given number of band screws, which pass through it and act upon the back of the article veneered, thus forcing the veneered surface against the band which adapts itself to the form of said surface. The claim is to the combination of the screws and bands, as described.

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13. For a *Cooking Range;* Herbert H. Stimpson, Boston, Massachusetts, March 14.

This range is provided with two side flues, built in the masonry, and inclining inwards until they unite with the main flue above the mantle; at the bottom they are immediately back of the side boiler holes, so that the draft can be carried from each side of the fire-place under the side boilers. The range is also provided with a hollow column on each side, and these are united at top by a hollow mantel. The main improvement consists in a particular arrangement of damp-

ers and flues, by which the draft can be carried either directly into the side flues in the masonry, or up the front half of the side columns, and thence along the front to about the middle of the mantel, the draft is then returned along the back of the mantel, and down the rear half of the columns into the side flues. For this purpose, the mantel is divided by a partition across the middle, and by two plates running from each end to near the middle, into two double flues, and each column is also divided by a partition plate into a front and back flue. The damper consists of a plate which slides under the bottom of the column, (one for each,) and to the bottom of it is attached another plate at right angles with it, so that they move together, and thus enable the attendant to give the proper direction to the draft. If it is desired to heat the apartment, the draft is carried through the columns and mantel, and then into the side flues, but if the heat is wanted for cooking only, it is then carried directly into the side flues. The claim is confined to the construction of the dampers, as described, and to their combination with the side flues in the masonry, and with the double flues in the columns and mantel.

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14. For a machine for *Breaking Dough;* John W. Post, Baltimore, Maryland, March 14.

This is alleged to be an improvement on the old machine for breaking dough, by means of two cylinders, through which the dough is rolled; the improvement consists in the method of returning the dough to the cylinders to be again rolled, instead of replacing it by hand, as in the old way. One of the cylinders, and that the upper one, if they are placed one above the other, is nearly surrounded by small rollers revolving in a direction the reverse of that of the cylinder. The space between the cylinder and the rollers is equal to that between the cylinders, so that the dough is carried up by them and presented again to the cylinder to be re-rolled. There are knives or scrapers placed between the rollers to prevent the dough from being carried between them. The patentee says that the same thing can be effected by means of a belt and one roller, and a weighted tightening pulley to yield when the dough passes between the cylinder and the belt. The claim is to the "manner of carrying up the dough after it has passed through between the breaking cylinders, by means of the elevating rollers, or by means of the rollers and belts united, to feed the breaking cylinders."

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15. For an improved *Sluice Gate for Canal Locks,* and which is applicable to other purposes; George W. Hildreth, Lockport, N. Y., March 19.

The claim upon which this patent has been granted, will give as distinct an idea of the principle of this improvement as could be given in a short description of it without drawings—it is in the following words, viz. "What I claim as my invention, and desire to secure by letters patent is, "1st. The making of the gate in the segment of a cylinder revolving on a pivot at each end, and fitting against concen-

tric plates attached to the frame in which the gate moves, as herein described." 2nd. "I claim the placing of the pivots of the segment gate below the centre of the circle, (of which the segment gate is a part,) so that in closing the gate a close joint shall be formed, and by the same means a greater pressure of water is brought upon the gate above the pivots than below, which assists in opening the gate, as described." 3rd. "I also claim as a substitute for the preceding, the placing the pivots of the segment gate in the centre, and placing the plates against which the gate slides, a little eccentric thereto, for the same purpose."

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16. For improvements in the *Floating Dry Dock* for raising vessels; Joseph T. Martin, New York, March 19.

This is an improvement on that kind of floating dock described in the 14th vol. of this journal, page 252, and in the 22nd vol., page 239, December 20, 1837. The ends of the main trunks, or floats, have appended to them separate hollow floats, which slide up and down, in frames constructed for that purpose, in the ends of the trunks, and they are retained in their position by racks and palls, and provided with pumps to let in or take out water. The sections of the dock, or the trunks, are united together by beams passing through slides, which are governed by a series of levers, in such a manner as that the dock can be shortened or lengthened whilst under water, by removing the trunks farther apart, or drawing them closer together. In the trunks there are water cisterns provided with pumps, and these are united by pipes with the body of the trunk, so that if desired, any water which may have leaked into them, may be pumped out by the pumps used to discharge the water from the cisterns. The claim is in the following words, viz. "I do not claim as my invention the formation of a floating dry dock by the union of sections or floating platforms, nor do I claim as my invention the construction and use of end floats, or any of the separate parts of the above described floating dry dock. But the end floats heretofore in use, have had no machinery attached to them by which they might be filled with water when necessary, for the purpose of causing to sink, or aiding to sink, the floating dock, and have, in fact, been so constructed with the intention that no water should ever be admitted within them, and therefore I do claim as my invention the new and useful improvement herein before fully described, or any other method substantially the same, by which they are filled with water and emptied of the same, for the purpose herein set forth. In combination with this I do claim the application of racks and palls for securing the position of the end floats, as herein set forth. I do also claim the above described combination of machinery by which the dock is lengthened or shortened whilst the dock is under water. And moreover, I do claim the application of the cisterns within the main floats, ("or trunks,") with their appendages, in combination with the reservoirs whereby the same pumps that are used for filling the reservoirs, may pump out the leakage of the main floats."

17. For an improvement in the mode of *Packing Rotary Steam Engines;* John D. Akin, Columbus, Pennsylvania, March 19.

This improvement is only for the packing of those parts which present two or three faces. The part to be packed is provided with a groove, into which the metallic packing is fitted. This packing consists of two metallic plates put together by halving the pieces where they meet, in the manner of a square shouldered splice, and two screws, with conical ends, are employed to spread and force out the two halves, the conical end of each screw passing in between the end of one piece and the shoulder of the other; so that as the screws are advanced the packing will be forced out and spread endwise. This kind of packing is described as applied to the steam heads and sliding valves of a rotary steam engine. The claim is to the mode of packing "by means of the countersink, halved plates, and conical screws."

Perhaps this may prove to be an improvement in the manner of packing, and so far so good, but the difficulties in the action of the rotary steam engine will be but very partially removed by an improvement in the manner of packing only.

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18. For an improvement in the *Cooking Stove*, designed for burning coal; Reuben Jackson, Zanesville, Ohio, March 19.

This stove is provided with two fire chambers, one at each end, there being a separate flue and outlet into the chimney from each; the oven is placed between the two fire chambers. The bottom of each grate is below the bottom of the oven; one grate being lower than the other. The draught from the highest grate passes up along one end, over the top of the oven, and out at the side; and up from the other grate, over a plate which separates the grate from the oven plate, down the back, along the bottom, and out at the side into the chimney. The claim is to the arrangement of the oven between the two fire-places, so as to carry the draught in the manner described.

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19. For an improvement in the manner of covering *Spring Saddles;* Orren M'Cluer, Fredonia, New York, March 25.

The leather of the saddle seat, instead of being attached to the head of the tree, is attached to a spring which is fixed to the head of the tree, or to the straining web, which connects the spring and the back of the saddle. The skirts of the saddle lap over the covering of the seat sufficiently to allow the play of the spring, without allowing the edge of the covering of the seat to be drawn from under them. This arrangement allows full play to the spring without straining the covering of the seat. The claim is confined to this mode of constructing, or covering, saddles.

20. For a mode of *Stretching Cloth in the process of Fulling;* B. D. Whitney, and G. W. Lawton, Winchendon, Massachusetts, March 25.

The cloth is carried around a series of rollers, one of which has its surface cut into a right and left-handed screw, each commencing in the middle and running out to the end. As this roller or double screw revolves with the cloth drawn over it, it will stretch the cloth widthwise. The same object is more effectually attained by making the surface of the roller in sections, sliding from the middle towards each end; the surface being seared or grooved so as to take hold of the cloth. The sections or segments project at each end beyond the body of the roller, and the part which projects is provided with a roller which fits into a spiral groove in a stationary cylindrical block at each end, and the grooves are so arranged that as the segments move around when they come to that part of their circuit in which they meet the cloth, (which is only in contact with a portion of the circumference,) the segments move outwards, stretching the cloth from the middle towards each edge, and when they leave the cloth they are drawn in. The claim is in the following words, viz. "We claim stretching the cloth widthwise during the process of fulling, or after it is fulled and steamed, by means of the right and left threaded screws, or fluted segments, in manner as above described."

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21. For an improvement in *Grist Mills;* Edward Gray, Ulysses, New York, March 25.

This improvement consists in placing a pair of small stones in the eye of the runner to prepare the grain before it passes to the large stones. The under one of the two small stones rests upon the driver of the large runner, and revolves with it, and the upper one is driven in the opposite direction by a driver attached to a small shaft, which takes the place of the damsel; its lower gudgeon working in the upper end of the main spindle. The grain is fed into the eye of the small upper stone, and after being partially ground, passes to the large stones to be ground into flour or meal. The defects in the common grist mill, which the patentee says he has overcome, are, "1st. The slowness of the grinding performed around the eye of the common stones, owing to the slow movement of the runner at this part of it, and the consequent insufficient supply of prepared grain for flouring, or being ground into flour, which is accomplished by the surfaces of the stones near the circumferences thereof, where the movement is quicker. And 2nd, the introduction of too much cool air between the stones through the eye of the runner."

The claim is confined to the introduction of the small stones in the eye of the runner. Whether the alleged defects in the old mode are real; and whether, if they are so, they will be remedied by the proposed arrangement, are questions to be decided by the experience of the miller.

22. For improvements in the *Floating Dry Dock;* John Gilbert, city of New York, March 25.

This floating dock is provided with a double sliding gate at one end, through which the vessel enters, and the inside with a boat gate, which can be shifted along lengthwise of the dock, for the purpose of reducing its capacity for receiving vessels of different tonnage. The space between the outer sides of the dock and the inclined partitions or inside walls, is occupied by water-tight tanks, (or rather these spaces are divided by water-tight partitions or bulk heads,) connected with each other, and with a pump well, by means of pipes, governed by cocks or valves, for the purpose of filling them with, or emptying them of, water. On each side of the dock there is a platform running its whole length, on its outside, which is provided with railways and loaded cars, connected with a windlass, by means of chains, for the purpose of trimming the dock. There is a mode of framing or putting the timbers together, which is described, but which cannot be clearly explained in our narrow limits without a drawing. The claims are first to "the employment of a boat gate, in the manner described, for the purpose of dividing the machine into two compartments, in the manner and for the purpose described." "Secondly, the manner of employing movable loaded, or ballast, cars, which are made to run upon suitable rails, or ways, situated on the platform, extended out for that purpose, in order to regulate the centre of gravity of the apparatus, as described." "Thirdly, the particular manner of uniting or putting together the timbers of uniform size, for the construction of the platform and of the sides of the dock, which saves the expense of building stages, as set forth."

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23. For an improvement in *Breast and Pitch Back Water Wheels;* Edward Robbins, Jr., and William Ashby, Bordentown, Burlington county, New Jersey, March 25.

This improvement is designed to admit of the escape of the air which remains in the buckets after they have received the water from the flume, and allowing it to escape through openings in the sole or lining of the wheel, as the buckets, in their descent, are being immersed in the back, or tail race water. The buckets are either radial, or inclined to the radii, and do not reach the sole or lining of the wheel, but leave an open space between the two, which is closed by a flap either hinged to the back of the bucket, or turning on pivots in the shrouding, so as to operate as valves or shutters, the back or inner edge closing against the sole or inner lining directly above the hole made through it for the escape of the air in the bucket below. As the bucket descends, the back of the flap comes in contact with the water in the tail race, which opens it, and passes into the bucket following, forcing the air contained in the bucket above the water, out through the hole in the sole or lining. Were it not for this arrangement, the patentee says the "air would be carried down, and be forced to descend with the buckets through the back water. This carrying down of the air, it must be manifest, would offer a considerable re-

sistance to the motion of the wheel, and that it does so, is well known to us from the most satisfactory experiments which we have made. Having thus fully described the manner in which we construct our improved water wheel, and shown how the same operates, we do hereby declare that we do not claim, as of our invention, the application of valves to buckets, as we are aware that such application had been made prior to our use thereof, but in a way very different from that in which we have made it, and not effecting the same object, namely, the allowing of the free escape of air, and the free admission of water into the buckets, as they dip into the tail race, or back water, and thus preventing the carrying down of the air through said water. What we claim, therefore, as of our invention and desire to secure by letters patent, is the employment of valves in buckets of water wheels, such valves having the position herein described, and being used in combination with the openings through the soling of the wheel, that is to say, said valves forming an angle of 130°, more or less, with the radiating buckets, or with radii of the wheel, and closing against its soling immediately above the opening, for the escape of air."

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24. For an improved mode of constructing *Bedsteads;* Mahlon Gregg, Philadelphia, Pennsylvania, March 25.

This patent is taken for a mode of fastening the rails to the posts, and for tightening the sacking. The tenon on the end of the rail is conical, the smaller end being towards the rail, and they are turned of the solid material. On two opposite sides the conical part is cut off. The mortise in the post being made the reverse of the tenon, it will be evident that it will admit the tenon when presented in one direction and when turned will retain it. The mortise is so formed as to draw the joint tight by turning the rail inwards.

The sacking is attached to a frame inside of the rails, which frame is connected with them. Pins project from the inside of the rails on to which the pieces forming the inner frame slide; those on the side rails are provided with screws and nuts, or with slots and wedges, for the purpose of drawing the sides of the frames towards the rails. The end pieces of the inner frame are formed with inclined planes at each end, against which the ends of the side pieces rest, so that as the side pieces are drawn out, their ends being in contact with the inclined planes of the end pieces, will force them out also, and thus stretch the sacking in all directions. The claim is to this mode of forming the joints of bedsteads, and to the manner of attaching and tightening the sacking.

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25. For an improvement in *Ploughs;* William Bryant, Davidson county, Tennessee, March 31.

This improvement consists simply in attaching, behind the share or cutting part of the plough, a coulter, in such manner as that it shall enter and loosen the ground deeper than it is cut by the share. This coulter is attached to the beam which is extended farther back than usual. The claim is confined to this device.

26. For improvements in *Candlesticks;* William Church, a citizen of the United States, residing at Birmingham, in the county of Warwick, England, issued 31st of March, and patent to run 14 years from the 14th of June, 1838, the date of the English patent.

This patent was granted for a mode of holding the candle in the socket of a candlestick by means of springs arranged in the socket. There are various kinds of springs described and represented, the simplest of which is composed of a series of spring tongues arranged around the socket and attached at the bottom of it. The patentee says, "I desire it to be understood that I claim as my improvement in candlesticks, an elastic holder for the candle, connected to the socket by whatever means and however formed."

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27. For an improvement in *Soap Frames* employed in the manufacture of soap; Joseph Bolton Doe, London, England, issued March 31st, and patent to run 14 years from the 14th of June, 1838, the date of the English patent.

This is an improvement on the well known wooden frames. The improved frames are made of iron or other metal, or compounds of metals, and consist of a bottom plate placed on rollers, to facilitate removal, with the two side plates hinged to it—one end plate being cast with or bolted to each of the side plates, so that by letting down the two sides the ends are also opened, which leaves the cake or block of soap standing on the bottom plate to be cut into bars. After the block has been removed the sides are thrown up, and where the end plate attached to one side meets the other side plate the two are bolted together. The patentee says, "what I claim as constituting my improvement in soap frames is the constructing of such frames from metal or other material which is a good conductor of heat, in the manner herein described; that is to say, by making them in one entire frame, (in lieu of in separate frames placed over each other,) and having movable sides and ends secured together by bolts or other analogous devices, substantially as herein described."

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28. For a machine for *Removing Snow from Railroads;* Charles Lowbaert, Philadelphia, Pennsylvania, issued March 31st, antidated January 15th, 1840.

A platform is placed on the frame of a car above the wheels, and extending some distance beyond the sides of the car frame, to the forward end of which is attached an inclined plane descending to the rails of the road on which it rests, it being properly shod for that purpose. The vertical sides of this platform, which descends to the level of the rails, extend beyond the end of the inclined plane so as to cut the snow before the inclined plane begins to raise it. On the top of the platform there is a triangular frame with one of its angles placed in the middle of the junction of the inclined plane and platform, so as to have two of its sides run out beyond the sides of the platform, to divide the snow which is carried up the inclined plane and discharged

by it on each side. For the purpose of dividing the snow, which is carried up, unequally, should it be desired to discharge more on one side than the other, a board or cutter is hinged to the angle of the frame on the platform and runs out as far as the ends of the sides of the platform, its lower edge resting upon the inclined plane, so as to cut the snow which goes up the plane in unequal parts. This machine is pushed forwards into the snow by the locomotive. "What I claim as my invention," says the patentee, "and desire to secure by letters patent, is the method of dividing and removing snow on railroad tracks, &c., by means of an inclined plane constructed with sides as herein set forth; and of conducting the same from the machine by means of the raised platform, triangular frame, and wings, in combination with the foregoing arrangement, the whole being constructed and operating as described."

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29. For an improvement in the *Rocking Chair;* Samuel H. Bean, Philadelphia, Pennsylvania, March 31.

Instead of having the rockers placed at the bottom of the legs, they are attached to the bottom of the seat, and rock on a frame at the top of the legs. To prevent the seat from being thrown off the stool, there are two metal plates hinged to each rocker by a pin, to give them free play in the direction of the rockers, and passing through mortises in the rails on which the rockers play; they have a shoulder at the lower end which strikes against the under side of the rails should the seat rock too far. The front plate of each set is provided with notches, into which a catch can be driven to prevent the seat from rocking if desired. The patentee claims, as his invention, the "making the seat and stool of the chair in two parts, so that the seat shall rock on the top of the stool, instead of having the parts permanently united, with rockers on the legs of the stool as heretofore; and also the mode of connecting together the seat and stool by the vertical plates attached to the seat passing through the stool with shoulders projecting from the sides thereof which catch against the under side of the stool when the seat is rocked to and fro; and likewise the manner of reclining the seat at any angle required by the lock plates and catches in the hanging plates which receive them, as before described."

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30. For an improved mode of *Preparing Flax and Hemp* before cleaning and separating the fibres; Sands Olcott, New Hope, Pennsylvania, March 31.

The flax or hemp, rotted or not rotted, that has been partially broken is to be converted into an *endless rove or belt.* This may be done by spreading it upon a table, and twisting it so that it will hold firmly, and then splicing the two ends together.

The patentee says, "the advantages of this process are of all the others." "1st. It is more easily and *continually* subjected to the action of the machinery, that will separate the wood and split the fibres." "2nd. It is more easily handled and dried." "3rd. The fibres are kept straight and clear amid the process, and cause less

waste." "What I claim as new, and as my invention, is the shape in which I place the material to be worked, or in other words, the convertion of hemp or flax to be acted on into an *endless rove or belt*, so that it may continue to pass in and out of the machinery, after the manner of a belt."

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31. For an improved mode of constructing *Bales and Drivers for Grain Mills;* Ezra R. Benton, Ohio City, Cuyhoga county, Ohio, March 31.

The claim appended to the specification of this patent gives as clear an idea of the construction as could be given without a drawing; it is in the following words—the letters of reference contained in the original being omitted, viz. "What I claim as my invention, and desire to secure by letters patent, is the connecting of the *bale* and *driver* with corresponding prongs and depressions, constituting a three or two bearing coupling, said couplings being on a level, or nearly so, with a hemispherical depression in the centre of the bale, thus coupling the *bale* and *driver* together, at, or nearly at, the same distance from the face of the stone with the point of the spindle on which the stone is suspended and balanced, in the manner set forth." "I also claim giving the rounding or head form to the sides of the square of the spindle, for the purpose of enabling it to move freely within the mortise of the driver, notwithstanding any bending of the driver upon the spindle."

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32. For improvements in the *Condensing Apparatus of Steam Engines;* Daniel Treadwell, Cambridge, Massachusetts, March 31.

The claim attached to the specification will fully explain the principle of this condenser—it is as follows, viz. "In claiming letters patent for the condenser, as described, I would not be understood as intending my claim to embrace the general principle of condensing by an effusion of water upon the condensing vessel, nor for making said condensing vessel of numerous pipes or tubes, instead of one simple cavity. But my invention, for which I claim a patent, consists in forming the condenser with curved pipes, which pipes pass from, and return to, the same plate by which they are supported, and which plate covers the two cavities, into one of which the steam passes from the exhaust pipe of the engine, and the other receives the water formed by the condensed steam. This form of construction having the following advantages. 1st. All the pipes are supported by the same body. 2nd. They are all opened to be cleaned, by a removal of the back plate. 3rd. They are free to expand and contract without causing their ends to move. 4th. The outside of the pipes are open and exposed, so that they can be cleaned without removing any part on which their support depends. 5th. They are, by means of being secured by soldering to the plate, placed nearer together than in any other form of fixture."

33. For *Preparing White Lead Paint;* James N. Trovillo, Christiansburg, Virginia, March 31.

This improvement consists in incorporating with a given quantity of white lead, equal, or nearly equal, quantities of linseed oil and of pure water, preparatory to grinding the paint, by first carefully incorporating the water and lead, and then adding the oil, and also in subsequently reducing it to a proper consistence by the addition of the same materials in the same proportions. The patentee says, "I do not claim to be the first to have incorporated linseed oil and water together in the preparation of paint, with a view to economy in the use of the former article, this having been done by the aid of lime or other alkaline substances; but what I do claim, is the producing of this combination by the agency of white lead alone, substantially in the manner set forth, for the purpose of producing a mixture to be employed as a paint applicable to all the objects to which white lead paint is ordinarily applied."

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34. For an improvement in *Steam Boilers;* Jacob B. Eversole, St. Louis, Missouri, March 31.

The patentee states that the object of his improvement is to prevent the vapour, generated at the bottom of the boiler, from coming in contact with the bottom of the flue, and there forming a sheet, which prevents the water from coming in contact with the heated metal. This he effects by means of a semi-cylindrical guard plate of metal, which he places between the bottom of the flue and the bottom of the boiler, and supports by legs or rods resting on the latter. The steam that is generated at the bottom of the boiler, in rising, comes in contact with the bottom of the guard plate, which carries it up and prevents it from coming in contact with the bottom of the flue. It is evident, however, that the remedy will only be partial, for the steam which impinges upon the bottom of the guard plate, will soon elevate its temperature until it becomes nearly equal to that of the steam—and this will generate steam above the guard plate, which, in rising, will impinge upon the bottom of the flue. The claim is confined to the placing of a guard plate between the flue and the bottom of the boiler.

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35. For improvements in *Machinery for removing Stumps;* Miles C. Mix, Tompkins county, New York, March 31.

It would be useless to attempt to give a clear idea of this machine within the narrow limits of this notice, without drawings; suffice it to say, that the chain which is attached to the stump, and by which it is drawn up, is attached to a revolving shaft, on which it is wound as on a windlass, by means of a peculiarly arranged system of gearing, which facilitates the change of relative velocity between the point where the force is applied and the shaft on which the chain is wound. This shaft and gearing are placed in a frame provided with two wheels at one end, and a truck roller at the other, so arranged as to

allow the ends of the frame to rest on the ground, that the whole may be attached or anchored for operation.

The claim is in the following words, viz. "What I claim as my invention, is the particular manner of obtaining the power by the construction and arrangement of the gearing, as herein described, that is to say, the mode of operating by two or more sets of double pinions on two differential wheels through the intermedium, and by means, of an apparatus combined and connected substantially, as herein set forth."

Proceedings in an Appeal from the decision of the Commissioner of Patents, HENRY L. ELLSWORTH, ESQ., *rejecting the application of* JOHN F. KEMPER, ESQ., *of Cincinnati, Ohio, for a Patent for an improvement in the manner of stowing Ice.*

The Editor was employed by Mr. Kemper to solicit and obtain a Patent for "*certain improvements in the manner of constructing vessels for carrying and stowing ice, and also an improvement in the manner of stowing the same;*" which application was duly made, and the claim to the manner of constructing the vessels admitted, while that to the manner of stowing the ice, was rejected, by the Commissioner of Patents, as not being, in his opinion, the proper subject of a Patent, and upon this decision, the subjoined proceedings have been had.

Under the provisions of the 7th section of the act of July 4th, 1836, an appeal from the decision of the Commissioner was allowed, in certain cases, to a board of examiners, consisting of three persons, to be appointed by the Secretary of State. Several appeals were made under this act, but the mode of proceeding was liable to so many objections as to render the repeal of this provision not only desirable, but absolutely necessary; on the 3rd of March, 1839, "an act in addition to an act to promote the progress of the useful arts," was passed, the 11th and 12th sections of which are in the following words.

"SEC. 11. *And be it further enacted,* That in cases where an appeal is now allowed by law from the decision of the Commissioner of Patents to a board of examiners provided for in the seventh section of the act to which this is additional, the party, instead thereof, shall have a right to appeal to the Chief Justice of the District Court of the United States for the District of Columbia, by giving notice thereof to the Commissioner, and filing in the Patent Office, within such time as the Commissioner shall appoint, his reasons of appeal, specifically set forth in writing, and also paying into the Patent Office, to the credit of the patent fund, the sum of twenty-five dollars. And it shall be the duty of said Chief Justice, on petition, to hear and determine all such appeals, and to revise such decisions in a summary way, on the evidence produced before the Commissioner, at such early and convenient time as he may appoint, first notifying the Commissioner of the time and place of hearing, whose duty it shall be to give notice thereof to all parties who appear to be interested therein, in such

manner as said judge shall prescribe. The Commissioner shall also lay before the said judge all the original papers and evidence in the case, together with the grounds of his decision, fully set forth in writing, touching all the points involved by the reasons of appeal, to which the revision shall be confined. And at the request of any party interested, or at the desire of the judge, the Commissioner and the examiners in the Patent Office, may be examined under oath, in explanation of the principles of the machine or other thing for which a patent, in such case, is prayed for. And it shall be the duty of the said judge, after the hearing of any such case, to return all the papers to the Commissioner, with a certificate of his proceedings and decision, which shall be entered of record in the Patent Office; and such decision, so certified, shall govern the further proceedings of the Commissioner in such case: *Provided, however,* That no opinion or decision of the judge in any such case shall preclude any person interested in favour or against the validity of any patent which has been or may hereafter be granted, from the right to contest the same in any judicial court, in any action in which its validity may come in question.

SEC. 12. *And be it further enacted,* That the Commissioner of Patents shall have power to make all such regulations in respect to the taking of evidence to be used in contested cases before him, as may be just and reasonable. And so much of the act to which this is additional as provides for a board of examiners, is hereby repealed."

During the period that has elapsed since the passing of the foregoing amendments to the act of 1836, the Editor has been consulted by a number of persons proposing to appeal from the decisions of the Commissioner, adverse to their claims, but he has, in every instance, discouraged the making of such appeal, because in prosecuting it a certain expense must be incurred, and the probable result would be the sustaining of the Office by the Chief Justice. The considerations upon which this advice has been founded, have been that these decisions were, in most instances, believed to be correct, and that where their correctness was matter of doubt, it was not likely that the testimony and opinions presented to the judge would, in ordinary cases, make it clearly his duty to order a patent to issue. By ordinary cases, are intended those in which the question at issue is that of novelty in the invention; a question to be decided upon the substantial identity of two machines, somewhat different in form. This is frequently a very difficult question with the professed mechanician, and one which cannot be viewed as within the purview of those subjects with which it is the duty of a jurist to be familiar; the tendency, therefore, would be, in nearly all cases, to lean to the side of the office, as the Commissioner and Examiners must be supposed to be well acquainted with such matters, and not to have any interest adverse to that of the applicant for a patent. These officers the Judge may examine under oath, and their opinions and reasons must necessarily have great weight in his decision upon the appeal.

Persons who apply for patents do so, generally, under an impression that they have something which is new and useful, and when disappointed in their cherished hopes, by an adverse opinion in the

Patent Office, are prone to apprehend the existence of some improper motive, and not unfrequently ascribe to corruption any decision which contravenes their own opinions of what ought to be, and the Editor is aware that charges of this character against the office, have been extensively promulgated; from his constant intercourse with it, and his intimate acquaintance with its transactions, it is due equally to himself and to justice, here to declare, that he is convinced such charges have not even the shadow of a foundation as their basis. He has frequently differed from the office in matters of opinion, and has forcibly urged the claims of his clients where he has felt that they were just; the present is a case in point; he has believed, and does still believe, that Mr. Kemper had a perfect right to a patent. At the moment of penning these preliminary remarks, the Editor is not in possession of the decision of the Chief Justice in the matter, but anticipates with much confidence that it will be in favour of his client. Should it not be so, however, although he will feel much disappointment, he will, at the same time, be ready to distrust the correctness of his own views in the matter, as the question submitted is one of law, and therefore within the special province of the Judge, and is in the hands of one who is equally able and faithful in the performance of his duties. It was because the point at issue was a question of law that Mr. Kemper was encouraged to make the appeal, and in whatever way it may be decided, a rule will be established which will govern the course of the office in analogous cases.

Two years have elapsed since the passing of the law giving an appeal to the Chief Justice of the District, and as the present is the first appeal under it, there was no existing precedent to determine the form of procedure, the publication of all the documents in the case may be of some value as a guide in such as may hereafter occur. By the delay of a day, the decision of the Chief Justice would be known, but the wish of the Editor to publish the case immediately, and his distance from the press, induce him to send off the first part of his copy, in order that it may be in time for the current number of the Journal.

Washington, March 20th, 1841.

To the Commissioner of Patents.

Sir—As Attorney for, and in behalf of John F. Kemper, of Cincinnati, in the State of Ohio, I hereby appeal from the decision of the Patent Office, in the case of the application of the said John F. Kemper for a patent for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same." You are, therefore, hereby requested to take such steps in the premises as are directed and provided by the 11th section of the "Act in addition to an act to promote the progress of the useful arts," passed on the 3rd day of March, 1839; twenty-five dollars having been paid into the Treasury of the United

States, in conformity with the requirements of the act of Congress in that case, made and provided.

THOMAS P. JONES, Attorney for JOHN F. KEMPER.

Washington, December 14*th*, 1840.

To the Hon. WILLIAM CRANCH, *Chief Justice of the District Court of the United States for the District of Columbia.*

The petition of John F. Kemper, by his Attorney, Thomas P. Jones, respectfully represents, that he has made application to the Commissioner of Patents, for the grant of letters patent of the United States, for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same;" that the Commissioner of Patents has decided that a patent cannot be granted for the last item in his said improvement, to wit: "an improvement in the manner of stowing the same," which decision your petitioner verily believes to be in contravention of his rights as the inventor or discoverer thereof, for reasons which will be fully set forth, at such time as may be appointed, agreeably to the provision of the 11th section of the act of Congress, entitled "An act in addition to an act to promote the progress of the useful arts," passed on the 3rd day of March, 1839. Your petitioner having paid twenty-five dollars into the Treasury of the United States, and having also given notice to the Commissioner of Patents of this appeal.

All of which is respectfully submitted.

JOHN F. KEMPER.

By his Attorney THOMAS P. JONES.

Washington, March 14*th*, 1840.

To the Hon. WM. CRANCH, *Chief Justice of the United States Court for the District of Columbia.*

Thomas P. Jones, Attorney for John F. Kemper, presents the following statement, and plea, on the claim of said John F. Kemper to a patent for what is believed to be a new and useful discovery.

In the case of John F. Kemper, of Cincinnati, in the state of Ohio, who has made application to the Commissioner of Patents for a patent for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same;" a letter was received from the Commissioner of Patents, dated March 24th, 1840, of which the following is a copy.

Patent Office, March 24*th*, 1840.

"SIR,—The specification of your improved vessel for stowing and carrying ice is herewith returned for amendment in the claim, which is deemed to be too broad, the mode of arranging the ice by placing the blocks edgewise, cannot, in the judgment of this office, constitute a claim to a patent, as it is believed that every one has a right to pack away ice by placing the blocks either edgewise or in any other posi-

m. The mode of caulking does not present any thing substantially w, the same having long since been effected.

Yours, respectfully,

R. John F. Kemper. H. L. Ellsworth."

Care of Dr. T. P. Jones, Agent, Washington, D. C.

After the receipt of the foregoing letter, I had, on behalf of Mr. Kemr, several conversations with the Examiner of Patents, upon whose port the foregoing letter was founded, and as these did not result in ıy change of opinion, it was proposed to refer the question to the ıal decision of the Commissioner of Patents; upon this point, and ı some others, I subsequently corresponded and consulted with Mr. emper, and finally the question of his right to a patent under that ırt of his specification and claim which relates to the packing of ice gewise, was submitted to the Commissioner. The part in controversy, submitted, and as contained in the specification and claim, is in the llowing words.

"I have discovered that for the purpose of keeping ice for a great ngth of time, it is necessary, in stowing it, to place all the pieces lgewise, as when placed flatwise, small openings are formed through by the percolation of water, or otherwise; and that this injurious fect goes on increasing, and, eventually, producing a rapid destrucon thereof. This I obviate by carefully packing all the blocks edgeise, when, as experience has abundantly shown, no such effect is oduced. This mode of stowage applies not only to vessels but also ice houses, &c., and wherever ice is to be preserved.

"In the manner of stowing the ice, I claim the placing of the preıred blocks edgewise, in the manner, and for the beneficial purpose, ɜrein set forth."

On, or about, the 10th of September, a paper was placed in my ınds, by the Commissioner of Patents, of which the following is a ɔpy.

"Ice houses have been packed either by placing the ice on the edge, r flatways, indiscriminately; if one person finds that placed on the ıd keeps best, and uses accordingly, this is no invention.

"If apples keep best on the end, a patent would not be granted for ıe exclusive use of packing them thus, though generally they are ırown in promiscuously. If cider would keep better by placing the ottles horizontally, than allowing them to stand upright, this could ot be patented, as both methods are used; in neither case is there any ıing new. The applicant only uses the invention or directions of nother, and finds one course recommended better than another.

H. L. Ellsworth."

It appears to me that in the case in hand the office has entirely ıistaken its powers and its duties, and has assumed an authority not ıtended to be given to it by the legislature.

Under the laws of the United States patents are granted for "any ıew and useful art, machine, manufacture, or composition of mat-

States, in conformity with the requirements of the act of Congres that case, made and provided.

THOMAS P. JONES, Attorney for JOHN F. KEMPEI

Washington, December 14th, 1840.

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Yours, respectfully,

MR. JOHN F. KEMPER. H. L. ELLSWORTH."

Care of Dr. T. P. JONES, Agent, Washington, D. C.

After the receipt of the foregoing letter, I had, on behalf of Mr. Kemper, several conversations with the Examiner of Patents, upon whose report the foregoing letter was founded, and as these did not result in any change of opinion, it was proposed to refer the question to the final decision of the Commissioner of Patents; upon this point, and on some others, I subsequently corresponded and consulted with Mr. Kemper, and finally the question of his right to a patent under that part of his specification and claim which relates to the packing of ice edgewise, was submitted to the Commissioner. The part in controversy, so submitted, and as contained in the specification and claim, is in the following words.

"I have discovered that for the purpose of keeping ice for a great length of time, it is necessary, in stowing it, to place all the pieces edgewise, as when placed flatwise, small openings are formed through it by the percolation of water, or otherwise; and that this injurious effect goes on increasing, and, eventually, producing a rapid destruction thereof. This I obviate by carefully packing all the blocks edgewise, when, as experience has abundantly shown, no such effect is produced. This mode of stowage applies not only to vessels but also to ice houses, &c., and wherever ice is to be preserved.

"In the manner of stowing the ice, I claim the placing of the prepared blocks edgewise, in the manner, and for the beneficial purpose, herein set forth."

On, or about, the 10th of September, a paper was placed in my hands, by the Commissioner of Patents, of which the following is a copy.

"Ice houses have been packed either by placing the ice on the edge, or flatways, indiscriminately; if one person finds that placed on the end keeps best, and uses accordingly, this is no invention.

"If apples keep best on the end, a patent would not be granted for the exclusive use of packing them thus, though generally they are thrown in promiscuously. If cider would keep better by placing the bottles horizontally, than allowing them to stand upright, this could not be patented, as both methods are used; in neither case is there any thing new. The applicant only uses the invention or directions of another, and finds one course recommended better than another.

H. L. ELLSWORTH."

It appears to me that in the case in hand the office has entirely mistaken its powers and its duties, and has assumed an authority not intended to be given to it by the legislature.

Under the laws of the United States patents are granted for "any new and useful art, machine, manufacture, or composition of mat-

ter; or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known or used by others before his or their discovery or invention." Act of July 4th, 1836, sec. 6.

The powers of the office to grant or to refuse a patent are designated in the 7th section of the same act, where it is provided that "if on any such examination it shall not appear to the Commissioner that the same had been invented or discovered by any other person in this country prior to the alleged invention or discovery thereof by the applicant; or that it had been patented or described in any printed publication in this or any foreign country, or had been in public use, or on sale with the applicant's consent or allowance prior to the application, if the Commissioner shall deem it to be sufficiently useful and important, it shall be his duty to issue a patent thereof."

It is not pretended in either of the communications from the office, above cited, that the discovery in question is placed in either of the conditions that would justify the refusing of a patent, under the law. In that of March 24th it is said to be "believed that every one has a right to pack away ice by placing the blocks either edgewise or in any other position;" a right which most certainly is not disputed; but the same may be said of the use of any invention or discovery that has ever been made; every one had *a right* to make it, and having made it, if not injurious to the community, he would have had *a right* to use it; and were there not a law vesting an exclusive right in inventions or discoveries, under certain conditions, every one else would have had the same right; the averment in the foregoing quotation seems, therefore, not to be based on any tenable ground. Does it appear "that this alleged discovery had been patented or described in any printed publication in this or any foreign country, or had been in public use?" this is not pretended; nor is it alleged that "the Commissioner" does not "deem it sufficiently useful and important," and is it not, therefore, "his duty to issue a patent therefor?"

The allegation of my client as respects the beneficial results of his manner of stowing ice, has been made after repeated and comparative trials; and he is fully satisfied of the verity of the discovery; such being the fact, it does not require any laboured argument to show that it is a discovery of very great value. In stowing ice, the whole intention is to preserve it either on voyages or for domestic use; and any new mode of constructing an ice house for that purpose would, confessedly, be patentable. In the case before us, the office assents to the grant of a patent for the construction of a vessel in which the ice is to be stowed, but refuses one for a new manner of stowing it, because, according to its statement, "every one has a right to pack ice away by placing the blocks either edgewise or in any other position." So also every one had a right to build a vessel for preserving ice, just as Mr. Kemper has built his; and yet an exclusive right to its use is granted to him for fourteen years, whilst it is refused for an auxiliary means of attaining the same end.

The communication from the office, received, as above stated, on or about the 10th of September last, seems to me not to offer any valid reason for not granting the patent. Ice has been thrown, or packed, in

ice houses "indiscriminately;" and from this it seems to be inferred that a discriminating mode, which it is alleged and believed produces a new and useful effect, is not the subject of a patent; and why? because "if one person finds that ice placed on the ends keeps best, and uses accordingly, this is no invention." Is it no "discovery" for one to find out what had not before been known, that "placed edgewise," the blocks of ice will be preserved for a much longer time than when placed *indiscriminately?*

The illustration offered in the supposed case of apples keeping best on their ends may be passed over, as it is merely followed by a declaration "that a patent would not be granted for the exclusive use of packing them thus." Whether it would, or ought, to be granted, is not a question which I am called to discuss. The remark respecting cider in bottles is still less relevent, as it is stated that "both methods are used," and that, therefore, the laying them on their sides "could not be patented," a conclusion, the correctness of which is fully admitted; but how this is to be applied to a method of packing ice, which method *has not been used*, does not appear.

On the 4th of May, 1838, a patent for an improved mode of packing and stowing ice, was granted to Frederick Tudor, of Boston. The improvement consisted simply in filling the interstices between the blocks of ice with any nonconducting material, such as saw-dust, chaff, pulverized cork, or any other that may be preferred. The patentee says, "my improvement consisting entirely in the filling of the spaces usually left between the separate blocks of ice with any suitable nonconductor, it having been found that by so doing the ice is preserved from melting for a much longer period than usual." The main object in this case was, it is supposed, to exclude the atmospheric air. If the applicant had been told that every one had a right to pack away ice by placing chaff, &c., between the separate blocks, as well as to surround the whole mass with such materials, he would have been placed in a predicament like that of my client; but in this case the patent was granted, and most certainly for what was less obviously a new discovery then is the fact that by packing the whole mass edgewise, the ice will be preserved from melting for a much longer period than usual.

I might give a long list of patents for processes, or modes of procedure, in preserving animal and vegetable substances, by means extremely simple, which have been granted and sustained under the statute of monopolies in England, the wording of which is much more limited than our own statute in its enumeration of patentable subjects; and I might also cite many which have been granted, and I believe correctly granted, under the existing laws, by the patent office of the United States, which appear to rest upon a much narrower basis than that now demanded; but this I consider at present unnecessary, especially when addressing myself on a question of law, to one having the requisite materials at his command, and so much better prepared to use them aright, than I can pretend to be.

In deciding upon the right of an applicant to a patent the professed rule of the office is, "that where the question is at all doubtful, the

patent should be granted," as the final decision of the right, in such cases, belongs to the courts, and not to the Commissioner of Patents; this rule I am fully aware has, in most cases, been faithfully observed, and I am really at a loss, therefore, to perceive upon what ground it has been so widely departed from in the present instance. Is the proposed plan unquestionably old? This is not even hinted at. Is it "frivolous or injurious to the well being, good policy, or sound morals of society?" Assuredly not. [See 1 Mason 186, Lowell *v.* Lewis.] I therefore most confidently anticipate that your honour will see good ground to reverse the decision of the Commissioner of Patents, and direct that a patent be issued to my client, admitting his claim to "the placing of the prepared blocks edgewise, in the manner and for the beneficial purpose herein set forth."

THOMAS P. JONES, Attorney for John F. Kemper.

To the Hon. WM. CRANCH, *Chief Justice of the United States Court for the District of Columbia.*

The Commissioner of Patents presents to the Honorable Judge, the following as the reasons which governed him in the rejection of John F. Kemper's claim to a patent for a mode of packing ice in vessels for transportation, and in ice houses.

John F. Kemper of Cincinnati, Ohio, made application for a patent on the 20th of March, 1840, for "improvements in the manner of constructing vessels for the stowing and carrying of ice, and also for an improvement in the manner of stowing the same in vessels and ice houses."

No objection has been made to the grant of a patent for the novel construction of vessels for the transportation of ice as claimed by him, but the Commissioner of Patents decided that he was not entitled to receive a patent for the manner of stowing the ice by placing the blocks edgewise, nor for the caulking between the several blocks as described and claimed in his specification—the former because, in the judgment of the Commissioner, it could not constitute a legitimate claim to a patent, for the want of novelty; and the latter for the want of novelty. From the decision on the former, viz. the mode of stowing by placing the blocks edgewise, he has appealed, and to the latter, viz., the caulking between the blocks he has acquiesced.

The Commissioner indulges the belief that a bare statement of the objections to the grant of a patent for stowing ice by placing the blocks edgewise, without any laboured arguments, will explain to the Honorable Judge the soundness of his decision.

It will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation. The fact is too well known to need proof.—In vessels the blocks have been placed in every possible position with the view of saving room in stowing, and any one who has seen ice stowed away in ice houses must have observed that the blocks are frequently placed edgewise. If then blocks of ice have been thus placed, the position has not been invented by Mr. Kemper. What then has been

invented? Is it placing all the blocks edgewise? This is not, however, an invention, for it matters not whether two or one thousand blocks have been thus placed, as the greater or lesser number cannot constitute a claim to a patent. Is it then the discovery that blocks of ice thus placed will be preserved longer than when placed in any other position? The stress laid upon this fact by Mr. Kemper's attorney, in the specification, and in his argument, indicates that this is the main ground of his claim. If a discovery were the subject of a patent this would be a good claim on the score of novelty, but it is believed that the test of usefulness would have to be applied with great liberality, as it has been shown by experience that the more compact ice can be packed, the longer it will keep, for one large solid block will keep longer than several small pieces of an equal bulk placed side by side. It is believed that if ice were placed edgewise a passage would sooner be made for air or water, by the melting of the ice on the sides, than if laid flatwise; for, in the former case, water trickling down, would, by attraction, continue in contact with the block in passing from the upper to the lower edge, but in the latter, it would remain upon the surface and only in contact with as much of the ice as it could cover in a state of rest—but to return. A discovery, is to bring to light something which has had existence before, and the very reverse of an invention, which is the contriving or producing something which did not before exist. It is not deemed necessary to go into a minute investigation of the meaning of the two terms to be submitted to one who needs no such explanation. The decisions of the courts are replete with opinions against the grant of patents for discoveries except when the term is used as synonimous with invention. As, for instance, a learned judge argues, he who discovered atmospheric pressure was not entitled to receive a patent for such discovery, but he who invented the suction pump, contrived something which did not exist before, and was entitled to receive a patent for it. So of the barometer. And, again, the man who discovered that steam in expanding exerted great force, was not an inventor, but the one who contrived the steam engine was. The courts have also decided that the application of a known thing to a new purpose is not the subject of a patent.

A machine has been invented for a given purpose, and another person discovers that it can be advantageously applied to another purpose—this is to disclose or discover something not known before, but it is not inventing or contriving, and therefore not patentable. It cannot be seen by what process of ratiocination it can be shown that *position can be invented*—it has existed from the beginning of time, and cannot be the subject of invention. Nor can it be shown that, to discover by any series of experiments, or by accident, that a certain position of any thing produces a beneficial result, is an invention and patentable under the statute. As well say that a person who should discover that to plant a given kind of seed so many inches under ground would make it produce better, and that for it he would be entitled to receive a patent. Or that he who should discover that certain winds prevailed during the winter, and that to build houses with the gable

side towards such winds would make the house warmer, and that for such discovery he would be entitled to a patent. Or that he who should discover that piling wood vertically, instead of horizontally, would keep better, would, for that, be entitled to receive a patent, and thus prohibit all others from piling wood vertically. The grant of a patent for placing the blocks edgewise, for this purpose, would prevent any one from placing them in the same position for another object; and if it would prevent them from stowing away a whole cargo, it would prevent them from stowing away a part of a cargo, and thus all persons would be prohibited from placing blocks of ice edgewise. Can it be believed that the Legislature ever intended thus to restrict the public right? It cannot be. Other arguments might be advanced, but it is believed to be so plain as to need no other illustration.

The Commissioner will notice an argument advanced by Mr. Kemper's attorney.—He has referred to a patent granted to Frederick Tudor, of Boston, on the 4th of May, 1838, for an improved mode of packing ice, by filling up the interstices between the blocks of ice with any non-conducting material. This is cited as a precedent.

Upon a review of this patent the novelty does appear questionable; but it matters not, as the case is not in point—there is no analogy between it and placing blocks of ice edgewise. It was known that the interstices between blocks of ice would admit air, and that if the air should be of a temperature above the freezing point, the consequence would be the melting of the ice; this is a discovery and not patentable, but he contrived a mode of preventing it by filling up the interstices with some non-conducting material. This is an invention, and as such, the subject of a patent; but if the interstices between blocks of ice had been filled up with some non-conducting material before, for some other purpose, and Mr. Tudor had merely discovered that it would prevent the admission of air, and thus the melting of the ice, he would not have been entitled to a patent. This supposed case is analogous to Mr. Kemper's claim, but as the patent was granted for the contrivance, it bears no analogy. If the contrivance, or invention, patented by Mr. Tudor was not new at the time the patent was granted, then it only shows that the patent ought not to have been granted, but it is no argument in favour of the present claim.

The Commissioner will remark, in conclusion, that there is another and insuperable objection to the claim in question.

Mr. Kemper's application covers two separate and distinct inventions which cannot be included in or covered by one patent, viz—improvements in the construction of vessels for the transportation of ice, without reference to the manner of packing or stowing away the ice, and also improvements in the manner of packing or stowing ice in vessels and in ice houses. The two have no dependence upon each other. The vessel can be used for transporting ice packed in any manner,—and the method of packing can be used in vessels thus constructed, or in any other manner, or in ice houses of all constructions.

All of which is respectfully submitted.

Henry L. Ellsworth.

February 17th, 1841.

To the Hon. Wm. Cranch, *Chief Justice of the United States Court for the District of Columbia.*

Sir—As Attorney for Mr. John F. Kemper, I present to your consideration the following remarks in answer to the reasons given by the Commissioner of Patents for his rejection of the claim of Mr. Kemper, to his mode of stowing ice.

It is said, by the Commissioner, that he, Kemper, "was not entitled to receive a patent for the manner of stowing ice, by placing the blocks edgewise," "because, in the judgment of the Commissioner, it would not constitute a legitimate claim to a patent, and for want of novelty." It is also said that "it will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation. The fact is too well known to need proof." A *discovery*, it is also argued, cannot be the subject of a patent, and that "it cannot be seen by what process of ratiocination it can be shown that *position can be invented.*"

It is somewhat strange that it should be asserted that a *discovery* is not the subject of a patent, when the provisions of the constitution of the United States, upon which the patent law is founded, gives to Congress the power of securing "to authors and inventors, the exclusive right to their respective writings, and *discoveries.*" It is admitted that a *discovery*, taken abstractedly, is not patentable, but if the thing discovered be practically applied to produce a new and useful effect, the manner of attaining this end is patentable. The 6th section of the act of July 4th, 1836, provides "that any person having *discovered* or invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art," &c.

The question at issue is whether Mr. Kemper has made any such "new and useful improvement on any art" as to entitle him to the protection of the patent law; and, to the undersigned, it seems that few things are more palpable than the obligation to answer this question in the affirmative. Is it not admitted that the art of preserving ice is a useful art? Improved modes of constructing ice houses have been the subjects of patents both here and in England; the office, in the case before us, has allowed the claim to the manner of forming a structure for this purpose, but has refused it for a new method of stowing the ice, by which the end proposed is more effectually attained. Is it not an improvement in the art of preserving ice, so to dispose the blocks as that they shall be prevented from melting for a longer period of time than has heretofore been done? The assertion that "it will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation," appears to be based upon ground altogether untenable, as it certainly "will not be pretended," that in vessels or in ice houses, ice had ever been stowed away upon the system adopted by Mr. Kemper; and this new and useful improvement in the art is founded upon a discovery made by him, namely, that if a mass of ice be stowed away in such manner as that the part which formed

the edges in the act of freezing, are placed in the reverse position when stowed away, the process of melting, or thawing, will be thereby retarded. I will ask, Sir, had this discovery ever been made, or the improved mode of stowing, founded upon it, ever been practiced before by any other person? That this is the case is not pretended. To say that because in filling ice houses, or vessels, with ice thrown in at random, some of the pieces so thrown in would assume the position designated, the claim to a new system of stowing ice would be invalidated, is to assert that, the unsoundness of which is too evident to call for any laboured arguments for its refutation.

In the well known case of the achromatic telescope, invented by Dolland, it was shown that a Dr. Hall, of Scotland, had constructed two telescopes upon the same principle with that of Dolland's forty years before his invention of it, but had not pursued the matter either to his own benefit or to that of the public; Dolland was, therefore, held to be the true inventor, and his patent was sustained. In this case there was, on the part of Hall, study, design, and system; but we are now to be told that because in throwing or heaping together a quantity of ice in separate pieces, some of these pieces will fall in the position designated by Mr. Kemper, he is not entitled to a patent. It certainly, Sir, is not necessary to inform you, or the Commissioner of Patents, that it is a settled principle in law, that a patent cannot be invalidated by showing that something of the nature of the thing patented had fortuitously occurred, or had been produced, without its attracting due attention, and leading to any beneficial result. It is probable that there are but few of those processes in chemistry by which new compounds have been produced, and for which patents have been granted, that had not previously been accidentally and unwittingly performed; but would proof of this invalidate a patent? In the case before you, Sir, no such evidence can be stated, and the doctrine assumed, were it tenable, would invalidate a large proportion of the patents that have been issued and sustained.

The argument attempted to be founded on the matter of Tudor's patent, cited by me in my first communication, appears to be altogether forced and inconclusive. It is not pretended by me that a discovery *per se* is the subject of a patent; but every invention must be founded on some discovery; and when a fact is discovered, and this discovery leads to some new and useful procedure, such procedure becomes a patentable subject. The discovery may be made by one person, and the patentable application of it by another, and such is usually the case; but in the present instance, they are both the work of the same individual, Mr. Kemper having discovered that ice exposed to the action of those agents which dissolve it, is, when placed edgewise, affected by them much more slowly than when piled or packed indiscriminately, in the ordinary way; and upon this discovery he founds a new and useful system of packing or stowing ice, and of thus preserving it, unmelted, for a longer period than by any other mode previously adopted. We are informed that Mr. Tudor did not make any discovery, but that he invented a mode of preserving the blocks of ice from decay, by filling the interstices between them with some non-

conducting substance, that excluded the air. It is said that "if the interstices between blocks of ice had been filled up with some non-conducting material before, for some other purpose, and Mr. Tudor had merely discovered that it would prevent the admission of air, and thus the melting of the ice, he would not have been entitled to a patent." It is then asserted that "this supposed case is analogous to Mr. Kemper's claim." Such, however, is not the fact, there is not any analogy between the two cases. Mr. Kemper, in his claim, says, "In the manner of stowing the ice, I claim the placing of the prepared blocks edgewise, in the manner, and for the beneficial purpose herein set forth." His claim, therefore, is to the doing of a new thing, one that had never been done before, either by accident or design, and by which mode of procedure a new and beneficial result is secured.

The Commissioner is at a loss to see how it can "be shown that position can be invented;" and this declaration is followed by some observations respecting position, the incorrectness and inapplicability of which are, it seems to me, quite evident. The position in which propellers have been placed on steamboats; the position in which the buckets of such wheels have been placed, and of a thousand other things in which position constituted the leading improvement, might be cited in proof of the utter irrelevency of such a remark. Within a few days a patent has been granted to Mr. Wm. W. Van Loan, of Cattskill, New York, for placing the ordinary paddle wheels of steamboats in a position which they had not previously been made to occupy. Instead of standing vertically, they are placed obliquely, and the claim made, and admitted by the office, is in the following words. "These wheels are to be moved by means of cranks, or in any of the known ways in which propelling wheels are made to revolve; the only novelty in my invention being the *position* in which I place said wheels, and cause the paddles to operate. What I claim, therefore, as constituting my improvement, and desire to secure by letters patent, is the placing of the said wheels in the *position* herein fully made known and represented, so that they shall enter the water in a direction similar to that of oars in the ordinary process of rowing, the whole operating substantially in the manner described."

It is said by the Commissioner, in relationship to Mr. Kemper's mode of stowing ice, that "it is believed that the test of usefulness would have to be applied with great liberality." And this remark is followed by some conjectures respecting the supposed result of stowing ice edgewise. This, sir, I conceive, is not a question upon which the Commissioner is to decide. On this point I will merely quote from Judge Story's opinion in the case of Lowell *v.* Lewis, 1. Mason 132. "In my judgment the argument is without foundation, all that the law requires is that the invention should not be frivolous, or injurious to the well being, good policy, or sound morals of society. The word *useful,* therefore, is incorporated into the act in contradistinction to mischievous, or immoral. For instance, a new invention to poison people, or to promote debauchery, or to facilitate private assassination, is not a patentable invention. But if the invention steers wide of these objections, whether it be more or less useful is a cir-

cumstance very material to the interest of the patentee, but of no importance to the public. If it be not extensively useful it will silently sink into contempt and disregard."

It is now stated, for the first time, that "Mr. Kemper's application covers two separate and distinct inventions, which cannot be included in, or covered by, one patent," and the Commissioner avers that this "constitutes an insuperable objection to the claim in question." Although it is believed that the opinion thus given is not invulnerable, as the construction of the vessel, and the manner of stowing the ice are part and parcel of one single invention, the preservation of the ice, yet, waiving this consideration, the only result would be that my client must obtain two separate patents, instead of including the two claims in one. The matter before you, Sir, is not a question upon the payment of thirty dollars into the Treasury of the United States, but upon the right of my client to a patent for a new and useful improvement in the manner of preserving ice.

In conclusion, Sir, I will now refer to two cases of the grant of patents by the office, in addition to that of Tudor's, cited by me in my former statement and plea; my object in this case being to show that it has been the practice of the office to grant patents upon claims of a very doubtful character, and, as I believe, on the ground of their being doubtful. These cases are such as have been decided since the passing of the Act of July 4th, 1836, giving to the Commissioner of Patents a certain extent of judicial power in relation to the granting of patents, in addition to the ministerial duties imposed by the Acts of Congress formerly existing. I might cite a number of other cases, with a similar view, but I do not deem it necessary so to do.

On the 15th of February, 1838, a patent was granted to A. D. Ditmars, under the claim to "the preservation of grass for hay, by excluding it from the air, in sheet lead, in the manner set forth." This manner consisted in the forming of air tight bins, or boxes, in barns, &c., which boxes were to be lined with sheet lead, and the lids of which were to be secured down, either by soldering, or otherwise, in such manner as to exclude the air. The grass was to be placed in these boxes in its green state, but free from dew or rain, and it was avered that by this means it would be preserved from decay.

On the 16th of November, 1839, a patent was granted to John H. Stevens for an improvement in friction matches. This improvement consisted in the preserving of the matches from accidental ignition by covering them with a coat of varnish, and it is stated that for this purpose various substances might be employed; what is generally used "is a little solution of gum mastic made with spirits of turpentine, or of an alcoholic solution of gum copal, or of gum mastic; but other glutinous gums, resins, tenaceous matters, or compounds, may be used."

These cases will serve to show that the amount of novelty required by the office to justify it in the granting of a patent is but small, and such must necessarily be the case if its object is, as the Act of Congress establishing it indicates, to "Promote the progress of the Useful Arts," for under any other manner of procedure its tendency would be to

impede their progress. In the case of Ditmars, the patentee had made no new discovery, it having been a well known and long established fact, that the exclusion of air tended to retard putrefaction, but he had applied a well known principle to the attaining of a useful, and it may be, of a new, end; in his procedure there was very little of invention, and it is believed that his title to a patent must have been a matter of much doubt, and that in consequence of the existence of this doubt, the patent was granted to him.

In the case of Stevens, the novelty was, perhaps, still less than that in Ditmars. The coating of wood with varnish to protect it from moisture, and for other purposes, is a thing known to every person, yet as it was, no doubt, believed to produce a new and useful effect in its application to the friction match, the office ordered the patent to issue.

The right of my client to a patent, from the considerations urged, appears to me so manifest as really to render the demurring of the office in the matter, a subject of surprise, as I well know that the objections made have not originated in any improper motive, or bias; but I am compelled to believe that a doubt having been at first entertained and expressed, the pride of consistency, however unwillingly, has entered, to no small extent, into the reasoning upon which this doubt has been made to assume the form of absolute decision. In every case, and there have been a number, in which my clients have proposed to appeal from the decision of the office, adverse to their claims, I have advised submission, but in the present instance I have believed that the appeal provided for in such cases was due to a full and just examination of the matter in question.

All which is respectfully submitted.

Thos. P. Jones, Attorney for John F. Kemper.

Washington, March 14*th.*, 1841.

TO BE CONTINUED.

The Mathematical Power Loom.—By the introduction of this invention it is expected a powerful stimulus will be given to a staple manufacture in this country—viz., the linen trade, which has for many years been in a drooping state, chiefly owing to the low price of labour in Scotland. The mathematical loom is equally applicable to the manufacture of worsted, cotton, and all other fibrous substances. This machine is called a mathematical loom, because the quantity of weft, or woof, is determined by calculation or measurement, thus securing at pleasure cloth of any fabric or stoutness, and perfectly equal throughout. The pressure upon the warp-thread can be varied to suit the strength of the warp; so that the strongest or most delicate yarns can be woven, and a firm or soft fabric produced without any difficulty. This loom performs the whole work of weaving, and will produce a piece of cloth of the ordinary length without the alteration of any of its parts. It has woven two bolts, or thirty yards, of the heaviest sailcloth in twelve and a half hours; and the inventor has stated that he would undertake to do that quantity in less time.—*Durham Chronicle.* Athenæum, December, 1840.

Durability of Leather.—Visitors to the Hospital of St. Cross, near Winchester, are shown in the hall two leather stoups or black-jacks for ale, which are, upon pretty good authority, stated to be three hundred years old. Perhaps a more striking proof could hardly be advanced that there really is, for durability, "*nothing like leather.*"

Mechanics' Magazine, November, 1840.

Deposition of Moisture on Metals.—If we place, in an atmosphere saturated with humidity, a piece of polished zinc and a piece of tarnished lead in contact, when the temperature lowers, the lead becomes covered with dew, and the zinc remains dry without oxidising. It is thus with two different metals. The moisture settles on one only. If the effect be attributed to electricity we must conclude that the droplets are electrified positively.—*M. Bonsdorf. Annales des Mines.*

Mining Review, September, 1840.

Meteorological Observations for March, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	31	54	29.78	29.78	W.	Moderate.		Partially cloudy—do. do.
	2	36	56	.78	.85	W.E.	do		Lightly cloudy—do. do.
	3	34	48	.70	.70	NE.	do.		Cloudy—clear.
	4	34	42	.90	.90	NE	do.		Clear—do
	5	21	32	30 00	30 33	W.	do.		Partially cloudy—do do.
☺	6	25	32	.41	29 80	E.	blustering	2.00	Snow—rain and hail.
	7	36	45	29.32	49	W.	Brisk.		Clear—do. do.
	8	35	40	.54	.60	W.	do.		Cloudy—do.
	9	32	40	30 00	30 13	W.	do.		Lightly cloudy—do. do.
	10	33	36	.00	29 94	E.	blustering	.38	Cloudy—snow.
	11	30	39	29 92	30 00	E.	Brisk.		Lightly cloudy—clear.
	12	26	39	30.13	.05	E	do.		Lightly cloudy—sleet snow.
☽	13	30	44	29.23	29 30	W.	do.	1.00	Cloudy—flying clouds.
	14	32	41	65	.70	W.	do.		Clear—cloudy.
	15	22	32	30 06	30.15	W.	Moderate.		Clear—do.
	16	29	25	29 90	29.94	E.	Brisk.		Snow—do.
	17	21	28	30 20	30 22	N.	do.		Snow—cloudy.
	18	28	35	29.93	29.88	N.	do.	.60	Cloudy—hail and rain.
	19	33	52	.93	30.00	W.	Moderate.	.28	Clear—do.
	20	3[illegible]	70	30.00	29.91	W.	do.		Hazy—hazy.
⊗	21	38	56	.01	30.04	W.	Brisk.		Clear—do.
	22	34	54	.24	.20	E.	Moderate.		Hazy—do.
	23	52	60	29 78	29.11	S.	Brisk.		Cloudy—rain.
	24	32	57	.83	87	W.	Moderate.	.33	Clear—do.
	25	37	64	30.00	30 05	W.	do.		Clear—do.
	26	40	69	.10	.04	SW.	Brisk.		Lightly cloudy—hazy.
	27	49	70	29 90	29 90	S	Moderate.		Hazy—do.
	28	47	71	.80	.76	W	do.		Cloudy—do.
☾	29	43	41	.85	60	E	Brisk.	.43	Rain—do.
	30	40	40	.60	.85	W.NE.	Moderate.		Cloudy—do.
	31	26	49	30 20	30.[illegible]0	E.	do.		Clear—do.
	Mean	34 90	48.80	29.90	29.91			5.02	

	Thermometer.		Barometer.	
Maximum height during the month,	71.	on the 28th.	30.33	on the 5th.
Minimum " "	21.	" 5th and 17th.	29.23	" 13th.
Mean	41.85		29.905	

	…ts.									Hygrometer.					
	Co…	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1															
2	9⅔	2⅔	⅓	2⅔	⅓	5⅔	1⅓	.	7⅔	....	.	.... .	....	.	1290
3															
4	3	5	⅓	1⅔	3⅓	5⅓	⅓	.	1⅔	....	.	.....	....	.	1288
5															
6															
7	5	⅔	⅓	8	.	2⅓	.	.	9	....	.	.....	....	.	1295
8															
9															
10		6⅔	.	6⅓	1	9⅔	.	.	.	....	.	.....	....	.	1331
11															
12		1⅔	1	6⅔	.	3⅔	⅓	11	⅓	....	.	.....	....	.	1303
13		2⅔	.	2	.	18	.	.	.	....	.	......	....	.	1283
14															
15	⅓	3⅓	4	1	1⅓	6⅔	5	.	⅓	47.25	2	.....	....	.	1297
16		3⅓	.	3⅔	.	12	.	.	1	40.83	2	.....	45.69	2	1307
17															
18															
19		.	.	2⅓	.	20⅓	.	.	⅔	....	.	......	....	.	1284
20		2	.	7	⅔	4	.	1⅓	.	....	.	.....	48.73	.	1285
21															
22															
23															
24															
25															
26															
27		1⅓	.	2⅓	.	6	.	14	3	....	.	.....	....	.	1286
28															
29															
30		2⅓	⅔	5⅓	3	1⅔	⅓	6⅓	⅓	31.26	6	.....	40.41	6	1373
31															
32		.	.	20⅔	.	.	.	.	1	....	.	.....	....	.	1296
33		1⅓	⅓	3	.	1	.	1⅓	21	....	.	.....	....	.	1309
34															
35		2⅓	.	13	⅓	6⅓	.	.	⅓	....	.	.....	....	.	1301
36															
37		⅔	⅓	9	.	.	7	4	3⅓	....	.	.....	....	.	1294
38		3⅔	.	18	.	5	.	.	.	....	.	.. .	....	.	1287
39		4	⅔	8⅓	⅔	1	⅓	9⅓	⅔	....	.	.....	....	.	1308
40		7⅓	.	8⅔	.	4⅓	.	7⅓	.	....	.	...	....	.	1306
41															
42	⅓	12⅔	1⅓	⅔	.	1⅔	.	9	.	....	.	......	....	.	1299
43		1⅔	.	.	.	15⅓	.	.	3⅔	....	.	.....	....	.	1298
44															
45															
46		8⅓	.	7⅓	.	4⅓	.	5	⅓	....	.	.....	....	.	1440
47															
48															
49		3⅔	⅓	8⅓	⅔	2	.	8⅓	.	....	.	......	....	.	1292
50		5	.	⅓	.	13⅓	.	5	1⅓	....	.	......	....	.	1378
51		8	.	11⅔	.	⅓	.	.	.	....	.	.....	....	.	1293
52															
53															

METEOROLOGICAL REPORT FOR THE STATE OF PENNSYLVANIA, Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

NOVEMBER, 1840.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1	Philadelphia, .	Philadelphia, .	J. M. Hamilton, .	42.70	47.31	45.30	55.00	33.00	45.10	8⅔	20.00	35.11	8
2	Montgomery, .												
3	Bucks, .	Newtown, .	L. H. Parsons, .	38.76	48.38	40.30	60.50	28.75	42.48	⅔	24.00	35.87	.
4	Lehigh, .												
5	Northampton,	Easton,	Charles Elliot, .										
6	Monroe .	Stroudsburg, .	A. M. Stokes, .	33.03	42.48	42.00	60.00	22.00	39.17	11	....	....	.
7	Pike, .	Milford,	Ralph Bull, .										
8	Wayne, .	Honesdale, .	W. Richardson, .										
9	Susquehanna,	Silver Lake, .	E. Rose, . .	36.50	47.10	40.57	64.00	22.00	41.39	.	18.00	29.20	.
10	Luzerne, .	Wilkesbarre, .	W. F. Dennis, .										
11	Schuylkill, .	Port Carbon .	P. C. Lyceum, .	33.65	50.97	33.03	71.00	24.00	42.55	⅓	22.00	29.80	.
12	Berks, .	Reading, .	C. F. Egelmann, .	38.57	45.97	39.50	58.00	26.00	41.35	.	....	...	.
13	Chester, .	West Chester,	Wm. W. Jefferies, .										
14	Delaware, .	Haverford, .	Haverford School, .	36.40	44.93	40.60	59.00	27.00	40.64	.	25.00	34.45	1
15	Lancaster, .	Lancaster, .	Conservatory of Arts,	37.92	47.79	39.98	62.00	29.00	42.56	1	26.00	34.97	.
16	York, .												
17	Lebanon, .												
18	Dauphin, .	Harrisburg, .	J. Heisely, .	39.90	45.55	42.41	55.00	32.00	42.62	⅔	30.00	37.13	.
19	Northumberland,	Northumberland,	Andrew C. Huston,	35.43	46.27	38.70	57.00	26.00	40.13	.	21.00	30.43	.
20	Columbia, .	Danville,	C. H. Frick.										
21	Bradford, .												
22	Tioga, .												
23	Lycoming, .												
24	Union, .												
25	Mifflin, .												
26	Juniata, .	Mifflintown, .	J. A. Rinkead, .	33.22	48.86	35.76	66.00	24.00	39.28	3	....	....	.
27	Perry, .												
28	Cumberland, .	Carlisle,	Prof. W. H. Allen,										
29	Adams, .	Gettysburg, .	Prof. M. Jacobs, .	35.88	47.35	38.51	62.00	25.50	40.58	.	25.00	33.59	.
30	Franklin, .												
31	Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	33.37	46.52	37.80	64.00	22.00	39.23	1	....	....	.
32	Centre, .	Bellefonte, .	John Harris, .	34.11	45.42	36.22	56.00	21.00	38.58	12⅓	....	....	.
33	Potter, .												
34	M'Kean, .	Smithport, .	Richard Chadwick,	29.23	42.80	31.03	64.00	20.00	34.35	.	19.00	27.40	.
35	Clearfield, .												
36	Cambria, .	Ebensburgh,	Richard Lewis, .	29.83	42.09	32.45	76.00	18.00	34.79	2⅔	17.00	27.57	2
37	Bedford, .	Bedford, .	Samuel Brown, .	33.73	46.63	37.12	68.00	24.50	39.16	.	....	....	.
38	Somerset, .	Somerset, .	George Mowry, .	32.00	42.57	35.03	58.00	20.00	36.53	⅔	16.00	28.53	1
39	Indiana, .	Indiana, .	Richard White, .	38.03	45.50	35.30	66.00	20.00	39.61	.	....	....	.
40	Jefferson, .	Rose Cottage,	C. C. Gaskell, .										
41	Warren, .	Warren, .	C. S. Brown, .	41.33	47.77	46.48	65.00	31.00	45.19	.	31.00	40.70	.
42	Venango, .	Franklin, .	Wm. Connely, .	28.97	44.04	34.96	65.00	13.00	35.99	2	....	....	.
43	Armstrong, .												
44	Westmoreland,												
45	Fayette, .	Uniontown, .	J. P. Weethee, .	32.95	47.32	36.22	64.00	18.00	38.83	.	....	....	.
46	Green, .												
47	Washington, .	Cannonsburg,	Prof. A. H. Campbell,										
48	Allegheny, .	Pittsburgh, .	J. P. Bakewell, .	38.60	46.90	42.20	60.00	30.00	42.57	⅓	....	....	.
49	Beaver, .	Beaver, .	James Allison, .	33.60	47.22	35.80	64.00	21.00	38.87	1	....	....	.
50	Butler, .	Butler, .	Jacob Mechling, .	35.30	44.80	40.20	65.00	21.00	40.30	.	....	....	.
51	Mercer, .	West Greenfield,	S. Campbell, .										
52	Crawford, .	Meadville, .	J. Limber, .										
53	Erie, .	Erie, .	Park & Reid, .										

	County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1	Philadelphia	29.95	29.96	30.01	30.49	29.60	29.97	8⅓	16	6	8	6	3	....	..	1.960
3	Bucks	29.95	29.90	29.94	30.33	29.50	29.93	⅔	12⅓	15	2⅔	5	1	....	1	3.760
6	Monroe	29.45	29.47	29.48	29.75	29.20	29.47	10⅓	2⅔	11⅓	16	....	....	....	..	......
9	Susquehanna	28.00	27.98	28.00	28.40	27.47	27.99	.	14⅔	15⅓	.	1	2	1	..	0.481
11	Schuylkill	29.33	29.33	29.35	29.96	29.00	29.32	⅓	14⅓	15⅓	⅓	4	3	1	..	3.291
12	Berks	29.79	29.79	29.79	30.19	29.35	29.79	.	11	19	.	3	3	1	1	2.103
14	Delaware	29.51	29.47	29.49	29.90	29.05	29.49	.	14⅔	15⅓	.	5	2	....	..	5.307
15	Lancaster	29.43	29.39	29.40	29.83	28.91	29.41	1	16	13⅔	⅓	10	....	....	..	2.095
18	Dauphin	29.71	29.68	29.71	30.07	29.30	29.70	⅓	.	.	.	5	4	....	..	2.372
19	Northumberland	29.40	29.37	29.39	29.77	28.91	29.39	.	7⅔	22	⅓	5	3	....	..	2.951
26	Juniata	29.46	29.45	29.43	29.84	28.92	29.45	3	10	17	3	3	2	....	..	2.350
29	Adams	29.34	29.31	29.32	29.69	28.81	29.32	.	17	13	.	4	1	....	..	2.185
31	Huntingdon	29.30	29.28	29.27	29.64	28.80	29.28	1	17	13	.	3	4	....	..	.....
32	Centre	29.22	29.22	29.28	29.60	28.76	29.24	12⅓	6	11⅓	12⅔	....	....	....	..	......
34	M'Kean	27.97	27.95	27.95	28.30	27.58	27.96	.	8⅓	21⅔	.	4	5	....	..	2.327
36	Cambria	27.79	27.80	27.79	28.13	27.34	27.79	3⅓	9⅔	15⅓	5	2	3	....	..	......
37	Bedford	29.18	29.15	29.16	29.51	28.70	29.16	.	11⅔	18⅓	.	....	....	....	..	......
38	Somerset	27.83	27.84	27.83	28.22	27.40	27.83	½	10⅔	18⅔	⅔	3	6	1	..	1.666
39	Indiana	28.58	28.56	28.54	28.90	28.10	28.56	.	11	18⅔	⅓	9	1	....	..	1.670
41	Warren	28.75	28.74	28.76	29.11	28.40	28.75	.	10⅔	19⅓	.	3	3	1		5.077
42	Venango	29.00	29.00	29.00	29.90	28.48	29.00	5⅓	8⅓	16⅓	5⅓	4	2	....	..	2.805
45	Fayette	28.98	28.98	28.94	29.29	28.29	28.97	.	15	15	.	5	3	....	..	4.703
48	Allegheny	29.21	29.19	29.21	29.55	28.74	29.20	.	10⅔	19	⅓	3	2	....	..	1.256
49	Beaver	29.39	29.35	29.37	29.75	28.82	29.37	1	13⅔	15⅓	1	4	1	1	..	2.410
50	Butler	28.75	28.73	28.73	29.10	28.20	28.74	.	.	.	.	4	4	....	..	2.102

	County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Philadelphia	1⅓	⅓	5	.	⅓	.	1⅔	.	.	⅔	2⅔	⅓	2⅔	½	5⅔	1⅓	.	7⅔	....	.	....	....	.	1290
3	Bucks	1⅔	⅓	6⅔	2	.	.	⅔	⅓	⅔	.	5	⅓	1⅔	3⅓	5⅓	⅓	.	1⅔	....	.	.....	....	.	1288
6	Monroe	3⅓	.	2⅓	.	4	.	.	.	.	.	⅔	⅓	8	.	2⅓	.	.	9	....	.	.....	....	.	1295
9	Susquehanna	4	.	.	.	.	.	1⅓	.	1	.	6⅔	.	6⅓	1	9⅔	.	.	.	....	.	.....	....	.	1331
11	Schuylkill	1⅓	.	1	.	2	⅓	⅔	.	⅓	.	1⅔	1	6⅔	.	3⅔	⅓	11	⅓	....	.	.....	....	.	1303
12	Berks	2	.	1⅔	.	2	.	1⅓	.	⅓	.	2⅔	.	2	.	18	.	.	.	....	.	......	....	.	1283
14	Delaware	1⅓	2	2	1⅓	.	.	⅓	⅓	.	1⅓	3⅓	4	1	1⅓	6⅔	5	.	⅓	47.25	2	.....	....	.	1297
15	Lancaster	4	.	2	.	2	.	1⅔	.	⅓	.	3⅓	.	3⅔	.	12	.	.	1	40.83	2	.....	45.69	2	1307
18	Dauphin	3⅓	.	⅔	.	.	.	2⅓	.	⅓	.	.	.	2⅓	.	20⅓	.	.	⅔	....	.	.....	....	.	1284
19	Northumberland	4	.	3	.	3⅓	.	3⅓	.	1	.	2	.	7	⅔	4	.	1⅓	.	....	.	.....	48.73	.	1285
26	Juniata	⅓	.	⅔	.	.	.	2	.	⅓	.	1⅓	.	2⅓	.	6	.	14	3	....	.	.....	....	.	1286
29	Adams	4⅔	1⅓	⅓	.	⅓	.	.	⅔	1⅔	1	2⅓	⅔	5⅓	3	1⅔	⅓	6⅓	⅓	31.26	6	.....	40.41	6	1373
31	Huntingdon	.	.	.	.	8⅓	.	.	.	.	.	.	.	20⅔	.	.	.	.	1	....	.	.....	....	.	1296
32	Centre	⅓	⅓	.	.	1⅓	.	.	.	.	.	1⅓	⅓	3	.	1	.	1⅓	21	....	.	.....	....	.	1309
34	M'Kean	1	.	.	.	4⅓	.	2⅓	.	.	.	2⅓	.	13	⅓	6⅓	.	.	⅓	....	.	.....	....	.	1301
36	Cambria	.	.	⅔	⅓	1	.	2⅓	.	⅔	.	⅔	⅓	9	.	.	7	4	3⅓	....	.	.....	...	.	1294
37	Bedford	⅓	.	.	.	.	.	.	.	3	.	3⅔	.	18	.	5	.	.	.	....	.	...	....	.	1287
38	Somerset	1⅓	.	⅓	.	⅔	.	2	.	⅔	.	4	⅔	8⅓	⅔	1	⅓	9⅓	⅔	....	.	.....	....	.	1308
39	Indiana	⅓	.	.	.	⅓	.	⅔	.	1	.	7⅓	.	8⅔	.	4⅓	.	7⅓	.	....	.	...	....	.	1306
41	Warren	⅔	.	.	.	.	.	2⅔	⅔	⅓	⅓	12⅔	1⅓	⅔	.	1⅔	.	9	.	....	.	......	....	.	1299
42	Venango	.	.	.	.	.	.	9⅓	.	.	.	1⅔	.	.	.	15⅓	.	.	3⅔	....	.	.....	....	.	1298
45	Fayette	⅓	.	⅓	.	.	.	3⅓	.	⅔	.	8⅓	.	7⅓	.	4⅓	.	5	⅓	....	.	.....	....	.	1440
48	Allegheny	.	.	.	.	3⅓	.	⅓	.	3	.	3⅔	⅓	8⅓	⅔	2	.	8⅓	.	....	.	......	....	.	1292
49	Beaver	.	.	1	⅔	.	.	3	.	⅓	.	5	.	⅓	.	13⅓	.	5	1⅓	....	.	......	....	.	1378
50	Butler	.	.	⅔	.	7⅔	.	.	.	1⅔	.	8	.	11⅔	.	⅓	.	.	.	....	.	.....	....	.	1293

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JUNE, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 299.]

8. *On the number and form of the buckets of an overshot wheel.*—The question of the relative value of elbow and centre buckets has been already examined (p. 221) by experiments made upon the high overshot wheel No. I. The convenient size of wheel No. IV induced the committee to use it in the more extended examination of questions in reference to the number and form of buckets. The number of elbow buckets applied to it was changed from twenty to forty, and oblique buckets, as well as curved buckets, of two different forms, were experimented with. The forms and other particulars relating to these buckets are given in a former part of this report (Jour. Frank. Inst., vol. x, p. 297, Plate VIII.)

A comparison of the ratios of effect to power, and of the velocities with wheel No. IV, with twenty and with forty elbow buckets, is given in the annexed table taken from tables 1 and 2 (vol x., pp. 298 302, Jour. Frank. Inst.)

TABLE TWENTY-FOURTH.

Comparison of overshot wheel No. IV, with twenty and with forty elbow buckets.

Head above gate.	Width of aperture.	Table 1, forty buckets.		Table 2, twenty buckets.		Table 1, forty buckets.		Table 2, twenty buckets.	
		Ratio of effect to power.	Mean ratio.	Ratio of effect to power.	Mean ratio.	Velocity of wheel.	Mean velocity.	Velocity of wheel.	Mean velocity.
Feet.	Inches.					Feet.	Feet.	Feet.	Feet.
0.25	0.50	.911		.867		5.94		5.86	
"	0.75			.824				5.78	
"	1.00	.852		.750		5.29		5.71	
"	1.25	.833				5.22			
"	1.50	.798		.739		6.29		5.71	
"	1.75	.731	.825		.795	5.49	5.65		5.76
0.75	0.38	.795		.842		5.03		5.94	
"	0.50			.800				5.86	
"	0.75	.801				5.57			
"	1.00	.755				5.35			
"	1.25	.748	.775		.821	5.49	5.36		5.90
		Mean	.800		.808		5.50		5.83

The average of the ratios of effect to power is nearly identical in the two cases, and the velocities are in the ratio of one to 1.06.

In the individual experiments the advantage is sometimes in favour of one set and sometimes of the other. It seems then that there was no advantage gained by increasing the number of elbow buckets upon this wheel, the original number being twenty, and the space occupied upon the soling, in the clear, by each bucket being about eight and a half inches, or from centre to centre an arc of eighteen degrees.

In the annexed table the ratios of effect to power and the velocities of wheel No. IV are compared when it was furnished with forty elbow buckets and with thirty inclined buckets. The deductions for the forty elbow buckets are taken for comparison, because the results are more numerous than those with the twenty buckets. Experiments are taken, in which all the circumstances were the same, and which corresponded to maximum ratios of effect to power.

TABLE TWENTY-FIFTH.

Comparison of elbow buckets with inclined buckets. Overshot No. IV.

Head above gate.	Width of aperture.	Elbow buckts. table 1.		Inclined buckets table 3.		Elbow buckets, table 1.		Inclined buckets, table 3.	
		Ratio of effect to power.	Mean ratio.	Ratio of effect to power.	Mean ratio.	Velocity of wheel.	Mean velocity.	Velocity of wheel.	Mean velocity.
Feet.	Inches.					Feet.	Feet.	Feet.	Feet.
0.25	1.00	.852		.808		5.29		4.57	
"	1.25	.833		.781		5.22		4.34	
"	1.50	.798		.803		6.29		3.97	
"	1.75	.731	.803	.772	.791	5.49	5.57	3.81	4.17
0.75	0.75	.801		.770		5.57		3.25	
"	1.00	.755		.777		5.35		2.97	
"	1.25	.748	.768	.763	.770	5.49	5.47	3.61	3.28

As in the last comparison, the *ratio of effect to power with the two varieties of buckets appears to be the same*, but there is a *great falling off in the velocity of the wheel by the use of the inclined buckets.* Some of the experiments taken as corresponding to maxima do not appear, from an inspection of the table, to fulfil the condition of true maxima, but others are unexceptionable, and as all show the same falling off in the rate of motion of the wheel, it must be taken as proved.

The explanation of this fact is, probably, to be found in the more or less favorable direction in which the water strikes the wheel. An inspection of fig. 3, Plate VIII, (vol. x, p. 296, Jour. Frank. Inst.) and a comparison with fig. 1, of the same plate, will show that the direction of the oblique buckets was much less favorable to a transfer of the force of the impinging water in the direction of the motion of the wheel. As it appears that the velocity of the impinging water is the circumstance which determines the velocity of the wheel, it might be concluded that any difference in the force with which, or the mode in which, the water strikes the wheel will produce a change in the velocity of the latter. Hence a change in the form of the buckets of the wheel, or in the form of the gate, where the chute is not of considerable length, will affect this velocity. This is probably the physical explanation of some of the difficulties heretofore stated in the conclusions in reference to the velocity of the wheel. Before passing these in review, we propose to examine the relative value of elbow and curved buckets; the effect of the use of these latter in the wheel will strengthen the conclusions in reference to the oblique buckets.

A comparison of the same elbow buckets with the curved buckets

before referred to is accordingly given below. It will be recollected that the second variety of these buckets was formed by cutting away a portion of the extremities of the first. The table referring to these (vol. x, p. 370, Jour. Frank. Inst.) shows no proper maximum, but the experiment giving the greatest ratio of effect to power has been taken for comparison.

TABLE TWENTY-SIXTH.

Comparison of the elbow and curved buckets. Overshot No. IV.

	Ratios of effect to power.			Velocities of wheel.		
	Elbow buckets, table 2.	Curved buckets, table 4.	Curved buckets, table 5.	Elbow buckets, table 2.	Curved buckets, table 4,	Curved buckets, table 5.
Feet.				Feet.	Feet.	Feet.
0.25	.795	.766		5.77	4.36	
0.42			.793			3.36
0.75	.821			5.90		
1.75		.678			4.04	
2.75	.645			6.65		

The comparison of the two varieties of curved buckets was in a degree vitiated by the removal of the wheel from the breast, in the experiments recorded in table 5, but the conclusion is fully warranted by the experiments from table 4, that in regard to the *ratio of effect to power the curved buckets are nearly equal to the elbow buckets, while in reference to the velocity of the wheel they are much inferior to them,* when the water is delivered as in these experiments. The velocities of the wheel with the two kinds of elbow buckets, with the first form of curved buckets, and with the oblique buckets, were at a mean as 5.6 to 4.2, and 3.7.

The reason assigned for the reduction of the velocity by the use of the oblique or of the curved buckets would, if correct, render it probable that with the mode of delivering water to the wheel adopted in the experiments there would be a gain in the velocity of the wheel, used as an overshot wheel, by employing centre buckets. Accordingly it will be found, by referring to page 222, that the average increase in the velocity of the wheel, under various heads, was about five per cent.

Again, the application of the same principles satisfactorily explains why it was found in tables fourth and fifth (pages 147–8) that the velocity of the wheel differed when the different gates *a*, *b*, and *c*, were used to deliver the water; being on the average in the proportion of 1.115, to 1.305, and 1.245 for the three gates respectively. The examinations of the quantities of water discharged by the three gates, made in table eighth, (page 151,) and again in table thirteenth (page 219) showed that *b* and *c* acted, in fact, as adjutages in modifying

the flow of water from them, the increase in the quantity of discharge being attended with a decrease in the actual velocity of the water delivered to the wheel, from an increase in the real area of discharge by the aperture acting in part as an adjutage. The velocity calculated from the quantity discharged is thus greater than the actual velocity. Hence while the actual velocity of the wheel is increased by the more favorable direction in which *b* and *c* delivered the water to it, the velocity of the water calculated from the quantity discharged by the same gates is apparently increased also, and the ratio of the velocity of the wheel to the velocity of the water appears correctly, at a mean, as shown by table tenth (page 153,) to be constant.

A further confirmation of these views will be found in the experiments to be referred to subsequently, on the comparison of the mode of admitting water to the buckets of an overshot wheel through a chute and by drawing it from the surface of the forebay.

Many difficulties in relation to the variations in the velocity of the wheel, are thus satisfactorily cleared up by reference to a physical cause, which is adequate to explain them, and the mode of operation of which may be readily estimated, though all the attending circumstances are not sufficiently well known to admit of calculation. We are inclined to refer to this same cause the unexplained, but sufficiently well established, effect of variations in the quantity of water supplied to the wheel, that is in the aperture of discharge, (pp. 217–8) upon its velocity. Thus, in theory, the two practical conclusions from the experiments, the first referring to the effect of an increase of quantity and the second to the effect of a change in the form of the gate would be referred to one cause, the same, also, in fact which produces a change in the velocity of the wheel by a change in the form of buckets.

The conclusion is fully warranted, from these comparisons, that in any circumstances not included within the range of these experiments, in which the velocity of the water, or the mode of its transmission to the wheel, should be changed, a corresponding change would take place in the velocity of the wheel.

9. *Comparison of the mode of admitting water to an overshot wheel through a chute, or by drawing it directly from the surface.* The mode of making this comparison is fully detailed in the introduction to the tables relating to wheel No. IV, (Jour. Frank. Inst. vol. x, p. 296.) The sudden falling away of the ratios when the latter mode of admitting water was adopted, leaving no room to doubt in reference to the result, notwithstanding that no maximum is shown in either case by the table, (No. 5, parts 1 and 2.)

TABLE TWENTY-SEVENTH.

Comparison of the mode of supplying water to an overshot wheel through a chute, and by drawing it from the surface. Wheel No. IV.

Table 5. Parts 1 and 2.	Head above gate.	Head and fall.	Velocity of wheel.	Ratio of effect to power.
	Feet.	Feet.	Feet per second.	
Chute, ...	0.42	6.67	3.36	.793
From surface, .	0.23*	6.67	3.06	.606

* In the table this is erroneously given as 2.75 feet. It should be 2.75 inches.

The proportion of the ratios in the two cases is as .793 to .606, or as 1.31 to 1.00, and the velocities bear the ratios of 1.1 to 1. The result in reference to the velocities confirms the general conclusions before referred to, (page 365.)

10. *Delivery of the water to the wheel through two gates acting in succession.*—It is easy to see that the admission of water through two gates acting in succession may be advantageous, when owing to the construction of the buckets or the large quantity of water admitted to the wheel, the water does not enter the buckets readily, but meets with considerable impediment in its passage to the lowest part of the buckets. When the buckets are constructed with due reference to the quantity of water to be received by them, it does not appear probable that two gates acting successively can have any particular advantage over one. Experiments upon this subject were made with wheel No. III, the arrangements in reference to which are described in a former part of this report, (Jour. Frank. Inst., vol. x, p. 11, Plate VII.) The experiments which are most directly comparable are collected in the following table.

TABLE TWENTY-EIGHTH.

Comparison of the effects of a single gate delivering water to an overshot wheel, with two gates acting in succession. From table I, parts 2 and 3, and from table II, parts 1 and 2. Overshot No. III.

Head above bottom of gate.	Head and fall.	Aperture. a.	Aperture. b.	Ratio of effect to power. One aperture.	Ratio of effect to power. Two apertures.
Feet.	Feet.	Inches.	Inches.		
2.75	13.00		1.00	.689	
"	"	0.50	0.50		.724
3.75	14.00		$0.62\frac{1}{2}$	.631	
"	"	$0.37\frac{1}{2}$	0.25		.658
0.25	10.50	1.50		.669	
"	"		1.50	.670	
"	"	0.75	0.75		.692
0.75	11.00		1.50	.780	
"	"	0.75	0.75		.758
1.75	12.00		1.00	.726	
"	"	0.50	0.50		.754
2.75	13.00		1.00	.668	
"	"	0.50	0.50		.702
3.75	14.00	0.75		.654	
"	"		0.75	.604	
"	"	$0.37\frac{1}{2}$	$0.37\frac{1}{2}$		.678
			Mean	.677	.709

The reasons why the ratios of effect to power contained in this table fall short of those formerly commented upon are that the heads above the gate in the former part of the table have a considerable proportion to the head and fall, and that in the experiments contained in the latter part no breast was used. A reference to the individual experiments shows some uncertainty as to whether the ratios actually represent maximum effects or not, but in the advanced stage of the experiments at which these results were obtained, an experiment which did not promise well was frequently not continued to its close, and hence these conclusions are probably near the truth.

The average ratios with the single aperture and with the two acting successively appear to be .677 and .709, being in favour of the latter; the proportion is as one to 1.047 nearly. The average velocities in the two cases are more nearly equal, being 6.19 and 6.42, or in the proportion of 1 to 1.037.

11. *On the use of a breast with an overshot wheel.*—Experiments for comparing the results with an overshot wheel and elbow buckets used with a close breast and without a breast, were made with wheel No. III, and are contained in tables I and II referring to that wheel, (Jour. Frank. Inst., vol. x, pp. 12–16.) In the following table the conclusions are brought together. The part above the first line which gives a mean of the results, contains experiments made under precisely similar circumstances, except in reference to the breast, and the first and second columns of the table point out the experiments in tables I and II from which the numbers for the velocities of the wheel, and for the ratios of effect to power, have been obtained. In the part of the table below the first line of mean results, the averages of all the highest results under each head, with and without a breast, are given, bringing a greater number of experiments to bear upon the conclusion, but comparing these not alike in the circumstances of the aperture by which the water was admitted to the wheel.

TABLE TWENTY-NINTH.

Comparison of the results with overshot wheel No. III, with and without a breast.

Table I.	Table II.	Head above gate.	Head and fall.	Velocity of wheel.		Ratio of effect to power.	
				With breast.	Without breast.	With breast.	Without breast.
No. of the experiment.		Feet.	Feet.	Feet.	Feet.	Power = 1.	
3	1 & 4	0.25	10.5	4.52	4.40	.817	.670
8	10	0.75	11.0	5.20	5.51	.809	.780
13	15	1.75	12.0	5.94	5.78	.758	.726
16 & 34	18 & 19	2.75	13.0	6.65	6.86	.706	.685
40 & 49	21 & 31	3.75	14.0	7.39	6.80	.664	.627
		Mean		5.94	5.87	.751	.698
No. of maximum.							
1	3	0.25	10.5	4.52	4.20	.817	.677
1	2	0.75	11.0	5.20	5.72	.809	.769
1	2	1.75	12.0	5.94	5.61	.758	.740
5	2	2.75	13.0	7.08	6.86	.711	.685
5	6	3.75	14.0	7.22	7.29	.666	.657
		Mean		5.99	5.94	.752	.706

The mean of the several results obtained by the two methods just explained does not differ materially, particularly the mean of the ratios of effect to power, which appears to be in favour of the use of the breast in the proportion of .751 to .702, or of 1.06 to 1.00, under

the average of heads from 0.25 to 3.75 feet, and of head and fall from 10.5 to 14.0 feet. The velocity of the wheel being determined by that of the water impinging upon it does not differ in the two cases in question.

[TO BE CONTINUED.]

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 319.]

[Translated for the Journal of the Franklin Institute.]

15. *The Land Surveyor's Square.* This instrument resembles the head of a cane, (fig. 17,) in which is cut two rectangular vertical openings A C D G, O F E I, which serve as sights. The lower part of these openings is cut in the form of a window, and to direct them towards a signal, the eye is applied to the opposite slit. In the bottom of this head is a socket which receives the head of a staff and retains it there by friction. The extremity of the staff is shod with iron. To use this instrument, plant the staff vertically in the ground, and turn the square on its socket until one of the slits is on a line with some distant signal. Then without moving the instrument, place the eye at the other slit and have a signal put up on its prolongation. Thus a second line will be obtained perpendicular to the first. When the ground is rocky, a tripod is used instead of the single or jacob staff.

The land surveyor's square is used to trace on the ground, lines at right angles to each other; it can also be used to determine the area of pieces of ground. This is done in the following manner.

Suppose figure 20, Plate II, to represent the outline of the ground to be surveyed; go to different points in succession along the line A B, and find the places D, F, H, where if the instrument is placed, one of the sights will be directed along the line A B, while the other is directed on the respective angles or corners C, E, G, which limit the outline of the field. If this outline is a curve, it must be so divided into parts, that each may be regarded as a straight line. Place a signal at each station, D, F, H, and also at the angles C, E, G, and measure the lengths, A D, D F, F H, H B, and also that of the perpendiculars, C D, E F, G H. We have then all that is necessary to plot the outline and calculate the area.

For example:—Trace on the paper any indefinite right line *a b;* lay off on it with the dividers the distances *a d*, *d f*, &c. taken from the scale, which represent the distances measured on A B; then at

each division erect the perpendiculars, *d c*, *f e*, *h g*, also taken from the scale; the number of parts, in each case, taken on the scale, being the number of units, the lines measured on the ground. To get the figure *c a e b g*, nothing remains but to join the extremities of the perpendiculars by right lines. It is evident this plan is reduced to a horizontal plane, since all the distances measured were horizontal. If the object is to know the length of the sides and the angles of the polygon, they can be ascertained by the aid of the scale and the protractor.

This operation is intelligible to the most ordinary capacity; and hence the surveyor's square is in continual use; besides, it gives immediate results, as it is only necessary to calculate the trapeziums and triangles, into which the ground is divided.

When the field is not bounded by a right line, we take as a base a right line which traverses the field, and stake it out with signals. (Fig. 21.) The distances intercepted on the boundary, by perpendiculars from these signals, being assumed as right lines, the boundary is determined.

In this manner, the sinuosities of roads, streams, enclosures, &c., can be determined. But the inequalities of the ground, the difficulty of measuring horizontal distances, and the obstacles which intercept the view, added to the slowness of the operation, frequently make it necessary to use some other instrument.

The head of the land surveyor's square is generally made in an octagonal form, and with slits so cut as to make with each other angles of 45°. These are used on the same principle as those of 90°. To test the correctness of these angles, look through the sights, and place a signal in the direction of each, then turn the square on its socket until the adjacent sights are on a line with the signal, which the first sights covered; if the instrument is correct, the sights first looked through will then be in exact co-incidence with the next signal, &c.

16. *The Pantometer of M. Fouquier.* This instrument is an improvement on the square, (fig. 23, Plate II,) and is formed of a cylinder cut in two parts; the lower one, A B C D, is secured to a staff by the socket K, and the clamp screw P; the upper part E F G H, turns on an axis concentric with the first, so that the divisions traced on the edge E F, pass along those on the lower border C D. The fixed circumference is divided into degrees, and the arc passed over by the upper cylinder is given at *n*. The vernier *m* gives the fractional part of the degree. A slit is cut in the fixed cylinder at *a*, and another diametrically opposite at *b*, through the middle of which a horsehair is stretched vertically. The upper cylinder also has two

slits at *d* and *c*, the last of which is also furnished with a horsehair. Care must be taken that these sights, in both cylinders, correspond exactly with the zero points on the graduation of the lower limb and the zero point on the vernier. This is ascertained by placing the two zeros in coincidence, and looking at a signal.

The manner of using this instrument is very easy to understand. The two movements which the instrument has, namely, that of both the cylinders about the socket, and that of the upper cylinder about its axis, enable the observer to fix the lower sights on one signal, while those of the upper are directed towards another signal. The angle made by two visual rays, drawn through these sights from the point where the instrument stands, to the signal, is given on the circle C D, and the vernier *m*. This then is one means of measuring angles, and the use of the instrument in plotting will be seen in the article on the graphometer.

A compass is usually fixed on the top G H, by the aid of which, objects are laid down where obstacles interpose to obstruct the view. A spirit level is also attached, to enable the operator to place the axis of the instrument vertical.*

17. *The Graphometer.* This instrument is used to measure angles. It is formed like a graduated semicircular protractor, from 4 to 10 inches or more in diameter, furnished with alidades and mounted on a universal joint, such as has been described already, (No. 12.)

Perpendicular to the limb and near its periphery are placed two sights P, P, opposite each other. The plane which passes through these sights is perpendicular to the limb, and lies on the diameter marked zero and 180°. Another alidade L L, moves round the centre C, and, in all its positions, along the limb, in the direction of its radii. These sights are nearer to the centre than the others, and when the alidade is directed along the principal diameter, the hairs of the four sights should coincide, upon the eye being applied at the extremity. This alidade carries a vernier which enables the observer to read the fractional parts of a minute.

It is necessary that the centre of the graduated arc should be the axis of rotation, in order that the line of the fixed sights correspond with the diameter of zero and 180°, and that the line of sight of the movable sights also pass through the centre. These conditions being fulfilled, an angle is measured in the following manner. Turn the instrument in its socket, until the radius marked zero is directed on a signal; clamp the instrument and turn the alidade until the line of sight is directed on another signal. As it is difficult with the hand

* It is hardly necessary to observe that all the operations of the Land Surveyor's Square and Pantometer may be performed by any instrument capable of measuring angles.

to place the line of sight of the alidade exactly on an object, the tangent screw is used to complete the operation.

The universal joint is so constructed, that the plane of the limb can be made to assume a vertical position, the correctness of which is tested by a plumb line. The limb can also be made horizontal, for which purpose, two spirit levels n, n', are placed upon it, at right angles to each other. In this last case, the angle measured is that formed by the visual rays to the two objects, reduced to the horizon (fig. 22); in the other, the angle measured is vertical, and is the angular height of one point above another: and if the principal diameter is horizontal, which is ascertained by the spirit level, the angle is the angular height of the point above the horizon.

The graphometer is also furnished with a small compass, the north and south line or diameter of which is graduated 0° and 180°, and is parallel with the diameter of the limb. It serves to lay down on a map the magnetic meridian, and to direct the sights towards invisible objects, as will be described in the article on the compass.

The spirit levels and the compass are fixed on in such a manner as not to interfere with the movements of the alidade or the universal joint.

After moving the revolving alidade, care must be taken to look again through the fixed sights, to be assured that the instrument has not been moved; as it frequently happens, that the force applied to move the alidade, moves also the whole instrument, making it necessary to readjust the hair of the fixed sights upon the signal.

For the purpose of seeing objects at a distance, telescopes furnished with an object and eye-glass, are used in place of the sights. At the common focus of the two glasses, are two hairs at right angles to each other, one parallel and the other perpendicular, to the limb.

The fixed telescope is placed under the limb; the movable one above it. Their axes should correspond respectively with the zero points of the limb and the vernier. For the purpose of seeing objects not in the plane of the limb, each telescope is mounted on a shaft perpendicular to the limb, and has a limited vertical motion. To ascertain if the axes of the sights or of the telescopes are properly adjusted, direct both to the same distant object, and see if the zero of the vernier coincides with the zero of the limb. When it does not, there is an error of collimation, the value of which is the difference between the two zeros, and is a constant quantity which it is necessary to add to or subtract from the observed angle as the case may be. It is better, however, to destroy the error by moving the hairs. For this purpose, the hairs have a transversal motion given to them by the aid of lateral screws. A screw is also used to

give a motion along the axis of the telescope, to place them in the focus of the object-glass. The telescopes just described reverse objects; but no inconvenience results on this account.

For the purpose of discovering if the instrument is well centered and well divided, measure the angle formed by lines drawn from a station to two signals, by referring them to a third signal; the angle sought is either the sum, or the difference of the two angles measured. This done, change the position of the third signal, and the same operation should give the same result. Another mode is by measuring the three angles of a triangle, the sum of which should make 180°.

The Graphometer is used in many topographical operations, but it will be sufficient to describe the manner of projecting plans with it. Let A B C D E (fig. 24) be different objects situated in a country of which we wish to get the plan. Measure the length of a horizontal base A E, the position of which is so chosen that all or most of the objects can be seen from the extremities A and E, and that the angles subtended shall be neither too obtuse nor too acute, &c.

Then station the instrument at A, and measure all the angles included between the base line A E, and lines drawn to the other points; these angles are reduced to the horizon when the plane of the limb at the time of the observation is fixed horizontally; by this means we know the angles B A E, C A E, D A E, H A E, &c. This being done, remove the instrument to E, and measure the angles D E A, C E A, B E A, F E A, &c.* To avoid confusion, the values of all these angles should be recorded on a sketch, representing the objects in the order they were seen.

To plot the above, draw on paper a right line *a e*, equal in length to as many parts of the assumed scale, as there are parts in yards or feet, &c., found in the base line by measurement. From the point *a*, with the aid of the protractor or other instrument, (see No. 4,) draw the right lines *a b*, *a c*, *a e*, *a f*, &c., making angles with the base respectively equal to the angles observed at A; then from the point *e*, draw lines *e d*, *e c*, *e b*, *e f*, making with *a e*, angles equal to those observed at E. These lines will cut those first drawn at the points *b*, *c*, *d*, *f*, &c., shewing the positions of the several observed signals B, C, D, &c.

It may be proper to remark that with the aid of dividers and scale, the lengths A B, B C, C D, D E, &c., can be ascertained on the plot, although they were not actually measured. Moreover, if any object is invisible from one or both of the stations, the place it occupies on

* As a confirmation or correction, take some intermediate known point on the base and go through the same operation. Each required point will then be determined by the intersection of three lines.

the plot can be ascertained, by taking as a base the distance between any two other stations from which it can be seen; for example, the point I, visible from G and from F, is found by measuring the angles, I G F, I F G.

The Graphometer serves, as before shewn, to find the distance between objects which are inaccessible. It will soon appear, that it can be used to find the height of signals above the horizon. But as these propositions involve the resolution of problems in right line trigonometry, they will be treated of hereafter, (No. 45.)

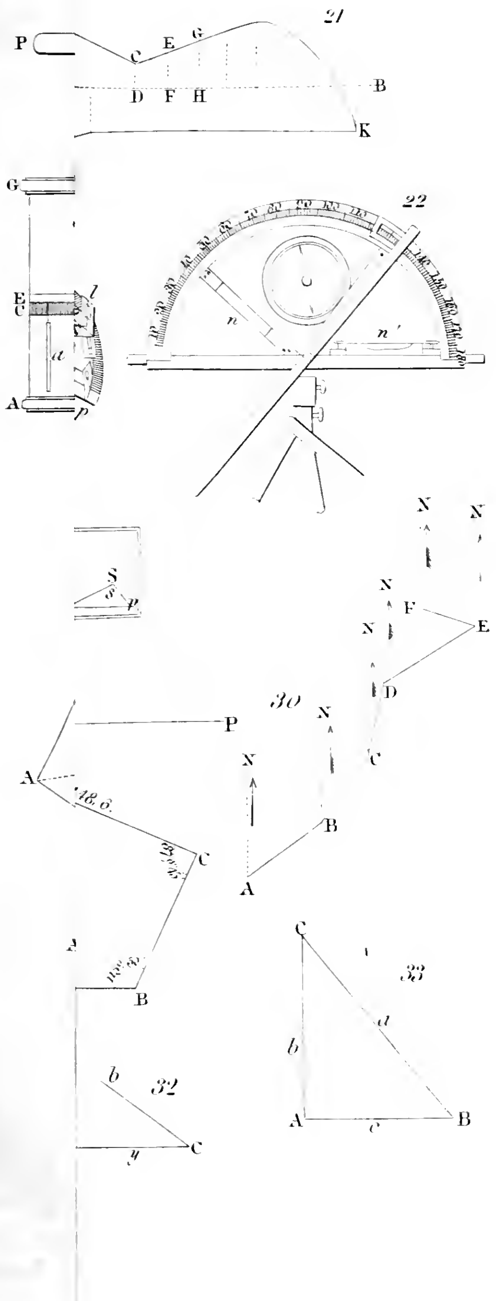
The method of intersections just described, saves much time and labour; but it is attended with the objection that it may be necessary to use angles that are very acute or very obtuse, which gives erroneous results. In this case it is best to make as many stations as there are signals, on the boundary of the locality to be surveyed, and measure the distance between the consecutive signals and the angles at each. Fig. 29 gives an example of this method, a more minute description of which is unnecessary here, as it will be found in the article on the plane table.

The repeating circle and the theodolite, which will soon be described, are also used like the graphometer to measure angles; but the complication of these instruments, the time it takes to adjust them and to make the observations, &c., prevent them from being used except in cases which require an extreme degree of precision, such as is seldom required in the details of topography. The sextant and the reflecting circle described in the treatise on navigation can be very conveniently used in measuring angles, more so than even the graphometer; but they give the true and not the projected angle.

[TO BE CONTINUED.]

Arching of Tunnels through Friable Rocks. *By* ELLWOOD MORRIS, *Civil Engineer.*

Where tunnels are cut through a material firm enough to sustain itself during the process of excavation, but not sufficiently solid to answer subsequently, without the protection afforded by an arch; economy and convenience usually require that the whole or nearly all of the excavation should be completed before the arching is taken in hand: for the darkness and contracted space in tunnels, render it quite difficult to work, advantageously, gangs of men employed at the same time, in two such different operations; the miners blasting and moving out material, and the bricklayers bringing in their bricks and mortar, all by the same railroad (unless two tracks are laid) produce interferences, the one with the other, which are found in practice to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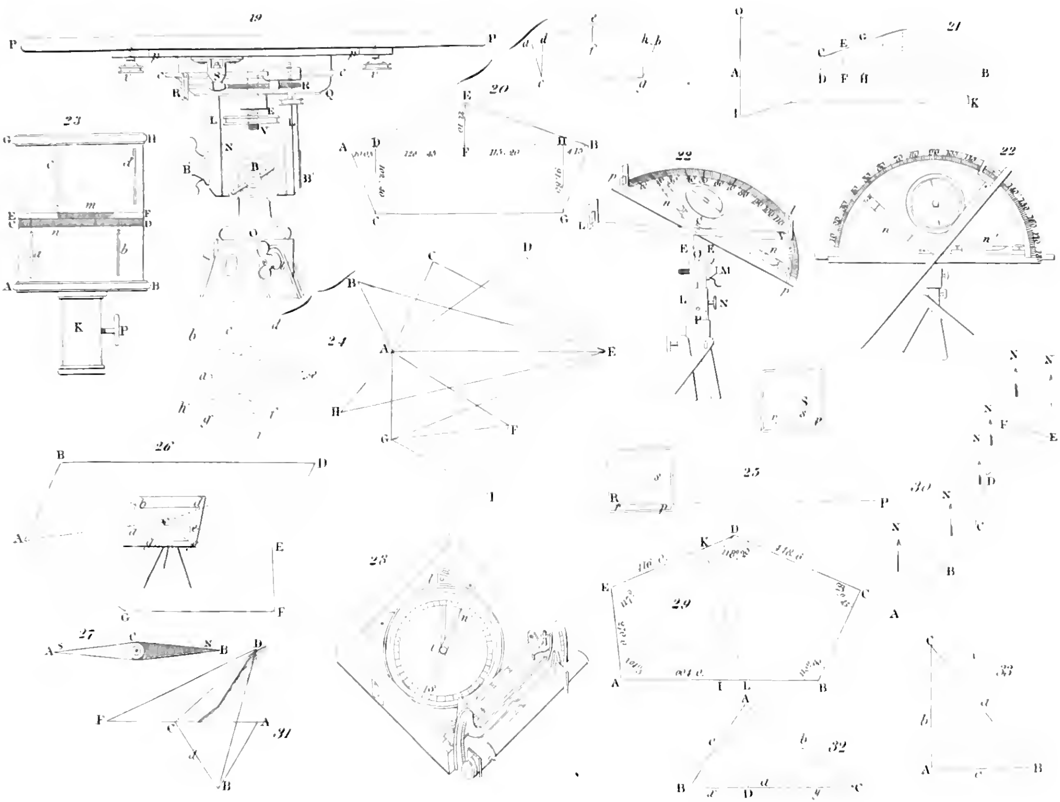
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be prejudicial to a just economy in execution, and often may require a longer time for the accomplishment of both, than if the labour was divided and each advanced independently.

Hence in tunnels through friable rocks it is usual, firstly, to perforate the hill and trim out the transverse section; secondly, to turn and pack the arch; thus dividing the construction into two distinct operations.

So much time is commonly consumed in the tedious process of tunneling that such works are almost invariably driven both day and night; and the excavation being accomplished, it will generally be necessary (in order not to detain the opening of the work for use) to press the arching forward with the utmost expedition: to do which requires some ingenuity in arranging the work and stationing the workmen, so as to be enabled to employ in the tunnel a powerful force; and this will be found impracticable in such confined situations, without peculiar arrangements different from what would be adopted in works in the open air.

The longest tunnel in America—that of the Chesapeake and Ohio Canal at the Pawpaw bend of the Potomac river—being 3,118 feet in length between its portals; is cut through a slate rock of such character that a thorough arch is indispensable to the safe and uninterrupted transit of boats: but the roof of rock being sufficiently firm to sustain the mass of the hill above, whilst it is not enough so to prevent continual and heavy scaling from the soffit, a light arch, *well packed,* has been designed to keep the material in place and make the roof safe; the side walls or abutments to be thirteen inches, or a brick and a half, and the arch nine inches, or one brick, in thickness; its span being twenty-four feet, and its intrados a semicircle.

This tunnel having been carried on with the intention of nearly completing the excavation before commencing the arch, and that part of the work being nearly done, it became the duty of the writer to devise the means of inserting this arch, with the least possible delay; and as it pertains to a subject of professional importance, an extract will be given from a late report to the Directory of the Chesapeake and Ohio Canal Company, with the hope that it may induce some of the writer's professional brethren to communicate their observations upon kindred subjects, through the pages of this Journal, which it affords the Committee on Publications great pleasure to open for the purpose of bringing forward their experience and views upon this or other matters of engineering.

Extract from a Report made to the President and Directors of the Chesapeake and Ohio Canal Company, by Ellwood Morris, *Chief Engineer, December* 31*st*, 1840.

As it has been imagined by some that the arching of the tunnel would require a very long time, it may be as well to give an outline of the plan upon which I have long contemplated proceeding with this portion of the work; and by the execution of which I have entire confidence that, with a heavy force, this formidable arch, though 3,118 feet long, and requiring about 3,500,000 bricks, can be constructed in a single year: the bricks being prepared beforehand and delivered at the portals.

By the experiment of Col. Pasley, of the Royal Engineers, of Mr. Brunel and others, the cohesive power of cement has been demonstrated to be so great, that from twenty to thirty bricks, with their longest dimensions vertical, had been stuck out horizontally from a wall, by adding successively a brick at a time, as soon as the cement joint of the preceding one had set.

Acting upon the principle of cohesiveness here developed; possessed, as it is in an eminent degree, by the hydraulic cement of the Potomac, which I contemplate using in the arch, at least without any admixture of sand, in order to procure a quicker set and firmer bond, I propose:

1. With a strong force to raise both side walls up to the springing line of the arch.

2. In sections of, say 500 feet, by reverse moulds and without centering, to carry up the arch on both sides to the angle of repose; and bringing into play the coherence of the cement, even above it, say to an angle of forty or even forty-five degrees, as may be determined at the time.

3. By a system of detached centres, framed to leave open about thirty degrees of the crown, each supporting three feet lineal of the arch, and leaving an interval of four or more feet to be sustained by the cohesive power of the cement, to carry up the spandrels of the arch to an angle of seventy-five degrees or within fifteen degrees of the crown on each side.

4. By a very light centre, (capable of being handled by two men,) to key up the crown in sections of two feet, shifting the crown centre continually, (upon a platform carried by the detached system,) as each successive section of the crown is keyed up and packed.

Those who are conversant with practical affairs, will at once perceive that, by working in long sections, course by course successively, the cement will set in one part whilst the workmen are engaged at

another; and that by the division of labour indicated in the above outline, a very large force can be employed upon the arch, and so organized as to finish each part in detail; the most tedious portion, that of keying up, being limited by the mode of operation, to thirty degrees of the crown alone, or but one-sixth of the semi-circle, can be advanced by working only from a single point, at the rate of ten feet lineal per day.

Oldtown, Md., April 18th, 1841.

Extracts from the Report of M. R. Stealey, *Resident Engineer of the Kentucky River Navigation, to* Sylvester Welch, Esq., *Chief Engineer of Kentucky. Dated Frankfort, December* 1, 1840.

"Notwithstanding the extraordinary efforts which were made in the fall of 1839, and continued through the winter, it was found impracticable to complete locks, and dams Nos. 2, 3 and 4, before the winter freshets occurred. The lock walls were not carried up to their full height—the machinery for working the gates was only temporarily and partially attached—the covering of the dams was incomplete—the approaches to the locks not fully formed—and the banks were in a degree unprotected from abrasion by the floods. It will be recollected that throughout the whole of last summer and fall, and indeed up to the middle of January, the Kentucky river remained at an unusually low stage. The timber which had been cut off the banks along the pools of dams Nos. 2, 3 and 4, during the summer, consequently lay where it had been felled until the dams were nearly completed. Upon the first rise in the river, the whole floated off and lodged in immense compact masses immediately above the several dams. At Cedar, dam No. 3, the gorge extended about a mile in length, and was probably from ten to twenty feet in depth. In the early part of February, the river rose to a considerable height, and the floating masses passed over the dams with great violence." * * *

"The repairs have been completed in a manner which, it is believed, will render them permanent. Dams Nos. 2 and 3 are filled with stone in all parts; No. 4 is not filled above the angle of the breast under the lower slope. In place of the spike bolts used heretofore, long key bolts, of inch and quarter square iron, have been used to secure all the upper range timbers to which the covering plank is attached; those bolts pass down through the lower timbers of the dam, are secured by keys underneath, and are not liable to

become loosened and drawn out by the tremor of the dam or the action of the water."

"The advantages of flat lower slopes to dams were clearly exemplified in the action of the water at the several sites. At No. 3 the greater portion of the lower slope of the dam, in its incomplete condition, was wrenched off, so as to leave a vertical face in the line of the comb; whilst at Nos. 2 and 4, the general outline of the slope remained undisturbed. At the former the water fell over vertically upon the rock foundation; at the latter, the water, guided and upheld by the slope, expended much of its force in a horizontal direction against the back water below. At No. 3 the rock was torn up to such an extent as to form a bar across the river, immediately below the dam, which has yielded rock sufficient to fill up the whole of the dam below the comb; at No. 2, on the contrary, which is built upon a gravel foundation, sand, gravel, brush, &c. were deposited to a depth of several feet against the lower side of the dam, and the foundation remained secure, although the gravel bed of the river was cut away at some distance below the dam: at No. 4 also the rock bed of the river remains unchanged. Again, at No. 3, the water, even at its highest stage, had a fall of about two feet, and at medium stages reacted from a line about one hundred feet below the dam, forming a rapid surface current, *up stream*, across the whole width of the river. The drift, in passing over, disappeared beneath the surface, rose below, and was then brought back against the dam with such violence that the shocks might be heard distinctly for the distance of a mile. In this manner large trees were seen to be worn, and rounded off at the ends, by repeated impingements against the dam, until finally the accumulation of their numbers forced them away to make room for others. At no stage of water could a craft of any kind have passed in safety over the dam. At Nos. 2 and 4, on the contrary, where the general outline of the slope remained unbroken, there was no reaction at the surface at any stage of water, and the ordinary drift passed directly off without detriment to the dams. At the highest stage of water (15 feet on the dam) there was but a very few inches difference in the level of the surfaces above and below the dam, and the water glided off with a gentle undulatory motion. Steamboats have passed, in both directions, over dam No. 2, and could have passed over No. 4, at the highest stage of water, had an opportunity offered. The slope of No. 3 is now replaced, and it is believed that the drift will in future pass over that, as at the other dams, without doing further injury.

The steamboat New Argo, Captain Armstrong, was the first to pass through the locks, and arrived at Frankfort on the 14th of

February. The navigation continued open, for steam and flat boats, so long as the river continued navigable below lock No. 2, with some intermissions resulting from the incomplete condition of the lock-walls."

* * * * "The whole cost of the improvements is estimated at $848,960, including superintendence, lime, purchase of land at the various sites, and all contingencies. The amount of work done is $746,046.32. Amounts paid as follows, viz: to contractors, $563,711.01; manufacture of hydraulic lime, $53,978.76; transportation of hydraulic lime, $22,641.58; clearing the timber from the banks of the river, $18,525.50; purchase of land, $2,776.48; superintendence, engineering and surveys, $24,837.02; making a total amount paid, $686,470.35. The amount due for work done, including retained per centage, $59,575.97; value of work yet to be done, $102,913.68; and the amount required to complete the improvement, in addition to the amount already paid, is $162,489.35." * * *

"It may not be uninteresting to the geologist, to state that in nearly all of our excavations, detached teeth and bones of the mammoth have been found, in a state of excellent preservation, at depths generally of fifty feet below the surface of the ground, and at distances of one hundred to one hundred and fifty feet from the margin of the river."

Extract from the Report of N. B. Buford, *Resident Engineer of the Licking River Navigation, in Kentucky. Addressed to* S. Welch, Esq., *Chief Engineer. November*, 1840.

"The lime which was used, during the last year, on the Licking river, was obtained from the establishment at Louisville. The quantity derived from that place was 3,695 barrels in the year 1839, and 1,400 barrels in the present year, which have been distributed among all the locks."

"It having been previously ascertained that near locks Nos. 1, 2, 4 and 5, a material existed which was capable of being manufactured into hydraulic lime, in the month of June, by your directions I commenced erecting a horse mill and kiln at lock No. 2, according to plans furnished by yourself. On the 18th of August, the kiln and mill were put into operation; and, as soon as a little experience had been acquired in burning the lime and attending the mill, they were found capable of answering the purpose for which they were intended."

"The mill, kiln, and a house for the hands employed about the establishment, have cost $1,600; and we are capable of manufactur-

ing 60 bushels of lime per day, at a cost of 25 cents per bushel. We have already made 3,600 bushels of lime, at a cost of $900, and apprehend that it will not cost more in future. The mill at No. 2, by being kept employed all the year, will be capable of making all the lime required for locks Nos. 1 and 2. The transportation of the lime to No. 1 will cost about 8 cents per bushel. If the amount required at the two locks should be 20,000 bushels, and the mill should be useless at the close of the work, its cost would be an increase of 8 cents per bushel on the lime made. So the lime at No. 2 would cost 33 cents per bushel; and that at No. 1, by adding the transportation, would cost 41 cents."

"The lime made has been fully tested, and found to be of a good quality. It does not set so readily as that from Louisville, but in two or three weeks it is equally hard."

Second Report of the Directors of the New York and Erie Railroad Company, to the Stockholders. February 3rd, 1841.

[CONCLUDED FROM PAGE 328.]

NOTE D.—TOLLS ON COMMON ROADS INCREASED BY RAILROADS.

"The report of the minister of public works in Belgium, states a remarkable fact, and one at variance with the anticipations of most persons. It was supposed that this new mode of transport, introduced to the extent now practised in Belgium, would destroy the old, and that the use of horses and ordinary carriages would be superseded. Such is not the fact. On the contrary, while railroads have been, in succession, extending themselves over the whole of the soil of Belgium, the produce of the tolls on the ordinary roads, instead of diminishing, has progressively increased. In proof of this, the following statement of the produce of the tolls is given:—

1831,	- - -	2,390,882 *fr.*	1836,	- - - -	2,447,985 *fr.*
1832,	- - -	2,195,343	1837,	- - - -	2,584,791
1833,	- - -	2,360,464	1838,	- - - -	2,759,543
1834,	- - -	2,415,769	1839,	10 months,	2,749,301
1835,	- - -	2,385,430			

Mr. Nothomb makes a comparison of the advantages to the public, in time and money, between the old mode of traveling by diligences, and the rate of traveling under the new tariff, which went into operation in 1839.

The average result is a saving of *half the time,* and of 33 per cent. in the price.

The saving in price is thus subdivided: in diligences 15 per cent.; chars-a-bancs 30 per cent.; wagons 60 per cent. It is the lower class who profit most by the establishment of railroads. They not only find the means of transport, which were almost denied them before, but they find the means of labour increased. It is officially stated in

this report that the building of the railroads of Belgium has produced the result of increasing the produce of all the indirect taxes."

Increase of Passengers by the Establishment of Railways.

"From Baron Charles Dupin's Report on the Paris and Orleans railway. Experience has proved both in France and abroad, that in a short space of time the facility, expedition, and economy afforded by railways more than doubles the number of passengers and the quantity of merchandize.

In order to support such statements, we will quote the following facts relative to the railways of Belgium, England, and Scotland, in positions of extreme difference, and giving rise to a variation in the returns which far exceeded all anticipations."

"Comparison of the number of travelers conveyed daily throughout the whole, or a portion of the line:—

Railways.	*Before the establishment.*	*After the establishment.*
Manchester and Liverpool,	400	1,620
Stockton and Darlington,	130	630
Newcastle and Carlisle,	90	500
Arbroath and Forfar,	20	200
Brussels and Antwerp,	200	3,000

Increase of the number of passengers by the establishment of a Railway:

Liverpool and Manchester,	300 per cent.
Stockton and Darlington,	380 per cent.
Newcastle and Carlisle,	455 per cent.
Arbroath and Forfar,	900 per cent.
Brussels and Antwerp,	1,400 per cent.

Thus, even taking as a criterion the road on which the proportional increase is least of all, we still find that the number of passengers will increase not only 100 but 300 per cent. The transport of merchandize will experience a similarly rapid increase.

Progress in the conveyance of merchandize by Railway, compared to that of passengers:—

Year.	*Passengers.*	*Tons.*
1834,	924,063	22,909
1836,	1,248,552	161,501
1838,	1,535,189	274,808

Thus while the number of passengers has increased 60 per cent. in four years, in the same time the quantity of goods increased 1,100 per cent."

Extract from a late official report on English Railways, made to the French Government, by Edward Teisserence, its agent, charged with the special duty of making a study of these Railways:—

"The Darlington Railway has produced, by its low rate of passage and of freight, a complete revolution, in the region of country which

it traverses. It has increased the value of land 100 or 200 per cent. By these low rates, the freight, estimated at 80,000 tons, has been increased to 640,000 tons. The passengers, estimated at 4,000, have been increased to 200,000."

The following extract on the influence of Railways in developing the resources of a country, is taken from the second report of the Irish Railway Commissioners.

"On the Newcastle and Carlisle road, prior to the railway, the whole number of persons the public coaches were licensed to carry in a week was 343, or both ways 686; now the average daily number of passengers by Railway for the whole length, viz: 61 8-10 miles, is 228, or 1,596 in the week.

The number of passengers on the Dundee and Newtyle line, exceeds at this time 50,000 annually; the estimated number of persons who performed the same journey previous to the opening of the railway having been 4,000.

Previous to the opening of the railway between Liverpool and Manchester, there were about 400 passengers per day, or 146,000 per year, traveling between those places by coaches; whereas the present number by railway alone, exceeds 500,000.

In foreign countries the results arising from the same cause, are equally, if not more striking. The number of persons who usually passed by the road between Brussels and Antwerp, was 75,000 in the year; but since the railroad has been opened from the former place to Malines it has increased to 500,000; and since it was carried all through to Antwerp, the number has exceeded a million. The opening of a branch from Malines to Termonde, appears to have added 200,000 to the latter number; so that the passenger traffic of that railroad, superseding a road traffic of only 75,000 persons, now amounts to 1,200,000.

It is remarkable, that on this, as on most other railroads, the greatest number of passengers are those who travel short distances, being as two to one compared with those who go the whole distance. This appears from a statement read by Mr. Loch, before the Statistical Society of Manchester, showing that between April 30th and August 15th, 1836, 122,417 persons traveled the whole distance, and 244,834 short distances; chiefly to and from Malines."

(NOTE E.) *The following is a statement of the whole cost (including the amount raised by loans,) the lengths, cost per mile, etc., of a few of the principal railways of Great Britain. In every instance, the cost which is given, includes the whole capital outlay, for roadway, buildings, cars, locomotives, etc. etc. The pound sterling has been taken at* $ 4 84.

Liverpool and Manchester.

Cost up to the 30th of June, 1840, $6,810,717, of which $3,726,195 is in stock, and the remainder has been raised by loans.

The length of the road is $30\frac{66}{100}$ miles.

The cost per mile has been \$ 222,137.

The whole capital of the company, on the 30th of June, 1840, including some items not properly chargeable to roadway and works, was \$ 6,847,665. The earnings for the previous six months were at the rate of $8\frac{4}{10}$ per cent. on this capital, per annum. Wherever the dividends exceed 10 per cent. per annum, the tolls are by law to be reduced.

There are three tunnels at Liverpool, the aggregate length of which amounts to 4506 yards, and which have cost more than \$ 1,500,000.

Stockton and Darlington.

Cost \$ 1,210,000: viz. stock \$ 736,000, and loans \$ 484,000.

Length of the main line,	25.38	miles.
Four short branches,	12.75	"
Total,	38.13	"

The cost per mile, including the branches, has been \$ 31,733. The dividends are £14 per each £100 share per annum, of which £10 per cent. is divided among the stockholders, and £4 per cent. is retained as a sinking fund. This road and its branches are used chiefly for the transportation of coal. Locomotive engines run on 24 miles; the remainder being worked by stationary engines and horse power.

Grand Junction.

The cost to the 30th of June, 1839, was \$ 9,300,000.

Length (from Birmingham to Newton,) $82\frac{63}{100}$ miles.

Cost per mile, \$ 112,550.

The whole amount of the company's stock at the present time, (all in shares or parts of shares,) including the cost of branches is \$ 10,664,335.

The net profits, during the years 1838 and 1839, were $8\frac{6}{10}$ per cent. per annum.

London and Birmingham.

The cost to the 30th of June, 1840, was \$ 27,580,135, viz: stock, \$ 15,125,000, and loans, \$ 12,455,135.

The length of the road is $112\frac{1}{4}$ miles.

The cost per mile has been, \$ 245,702.

This road yields a profit of about 9 per cent. per annum, on the paid up capital. The gross income for the year ending 30th June, 1840, was \$ 3,326,583, of which the receipts from passengers alone, were \$ 2,446,518. The cost of land has been \$ 30,000 per mile.

London and Southwestern, (or London and Southampton.)

Cost, \$ 9,943,228, viz: in shares, \$ 6,776,000; in loans, \$ 3,167,228.

Length, $76\frac{7}{10}$ miles.

Cost per mile, \$ 129,639.

Great Western.

This road is not yet completed. The amount expended up to the 30th of June, 1840, was $ 21,819,494.

The whole length of the road will be $117\frac{4}{10}$ miles, of which 75 miles are now in use, viz: 63 miles at the London end and 12 miles at the Bristol end.

It is estimated that this road will cost upwards of £ 50,000 per mile, say upwards of $ 242,000.

The average number of passengers per day, on the London end of the line, for the last two and a half years, has been upwards of 1500. Up to the 30th of June, 1840, the amount paid for lands and expenses relating thereto, was $ 3,475,449, being at the rate of more than $ 2,420 per acre, or $ 29,000 per mile.

Newcastle and Carlisle.

Probable cost, $ 4,598,000, that being the amount authorized by parliament to be raised. Of this there is in stock, about $ 2,613,600 the remainder having been raised by loans.

The length of the road is $61\frac{83}{100}$ miles.

The cost per mile has been $ 74,360.

Railway Property as an Investment.

"A correspondent calls our attention to the extraordinary increase in the value of railway property, which has taken place within the last six months. Comparing the quotations in our share list of the 14th of December last, with those of the 13th inst., it will be seen that upon twenty lines this increase amounts to upwards of *eight millions sterling!* Thus the Great Western shares in that period have risen 52*l.* per share, namely, from 10 discount to 42 premium, equal to 1,300,000*l.* upon 25,000 original shares; the new shares have risen from 5 discount to 20 premium, equal to 625,000*l.*—making altogether 1,925,000*l.* upon the old and new shares. The London and Birmingham shares have in like manner risen from 50 premium to 99 premium, equal to 1,225,000*l.* upon the 25,000 original shares; the quarter shares have risen from 22 to 30 premium, equal to 200,000*l.*; and the new shares have risen 13*l.*, equal to 405,950*l.*; making altogether upon the shares a sum of 1,830,950*l.* The shares of the other lines in the following table, are computed in the same manner:

Great Western, - - - -	£1,925,000
London and Birmingham, - - -	1,830,950
Grand Junction, - - - -	829,000
London and Southwestern, - - -	612,000
Eastern Counties, - - - -	488,000
North Midland, - - - -	420,000
London and Brighton, - - - -	360,000
Manchester and Leeds, - - - -	312,000
Midland Counties, - - - -	240,000

Manchester and Birmingham, - -	180,000
London and Croydon, - - - - -	165,000
Great North of England, - - -	150,000
London and Blackwall, - - -	120,000
York and North Midland, - - -	120,000
Birmingham and Gloucester, - -	95,000
Chester and Crewe, - - - -	90,000
Bristol and Exeter, - - -	90,000
Cheltenham and Great Western, - -	75,000
Birmingham and Derby, - - -	63,000
London and Greenwich, - - -	60,000
	£ 8,224,959

These results cannot fail, as our correspondent remarks, to be most gratifying to Railway proprietors, as showing that public opinion has undergone a change; that railways are no longer viewed with suspicion as the mere speculation of a day, to be spoken of in the same breath with Spanish bonds, &c., but that they are regarded as real and valuable investments in the soil."—*Railway Times.*

Dangers of Railroad Traveling.

"It is ascertained by experiment, that the danger of loss of life on an average railroad trip is about 1 to 4,000,000. The following data on which this conclusion is founded, are copied from a late British publication:

Name of Railway.	*No. of Miles.*	*No. of Pas.*	*No. of Accidents.*	
London and Birmingham,	19,119,465	541.360	3 cases of contusions, no deaths,	(1)
Grand Junction,	97½*	214,064	2 cases of slight do,	(2)
Bolton and Leigh and Kenyon and Leigh,	3,923,012	508,763	2 deaths, 3 slight contusions,	(3)
Newcastle and Carlisle,	61*	8,540,759	5 death, four fractures,	(4)
Edinburgh and Dalkieth,	8*	1,557.612	one arm broken,	
Stockton and Darlington,	2,213,681	357,205	none.	
Great Western,	4,100,538	230,408	none.	
Liverpool and Manchester,	31*	3.521,820	8 deaths, no fractures,	(5)
Dublin and Kingston,	6*	26,410,152	5 deaths and contusions to pas'gers,	
London and Greenwich,	484,000	2,880.417	one passenger slightly bruised.	

* Length of road.

(1) None of these accidents occurred to actual passengers.

(2) None of these accidents occurred to actual passengers.

(3) None of the persons killed were passengers.

(4) One of the persons killed was a passenger.

(5) The whole of these were passengers; one of them a sergeant in charge of a deserter, who jumped off the carriage whilst in motion; the sergeant jumped after him to retake him, but was so much injured that he died; three others got out and walked on the road and were killed; the rest suffered by collisions of two trains, at different times. These include all the casualties from the very commencement of the working of the line."

(Note F.)

Statement of the cost, annual expenditures, receipts, etc., of several railways in the United States.

Name of Road.	Length in miles.	Total cost.	Expenses per annum.	Receipts per annum.	Profits per annum.	Per centage of profit.	Number of through passengers.	Number of way passengers.	Total number of passengers.
Utica and Syracuse, July, 1839, to July, 1840.	53	941,475	65,648	197 923	132,275	14	74,034	55 802	129,836
Utica and Schenectady, 1839,	78	1 855 052	119 630	400,671	281,041	15	95 776	86,823	182,599
Boston and Lowell, 1839,	26½	1,6[illegible]8,476	92 151	241,2 9	149,068	9	130 000		
Boston and Providence, 1839,	41	1 582,000	194,411	313,907	119,496	7	130,000		
Boston and Worcester, 1839,	44	1,848,085	126,384	231,807	105,423	6	90,000		
Camden and Amboy, 1839.	61	3,220,857	258,043	685,329	427 286	13¾			181,479
Philadelphia, Wilmington and Baltimore, 1839.	9 7	4,379,225	169 130	490,63[illegible]	321,505	7½			213,650

Note.—The whole number of passengers on the Boston and Lowell, Boston and Providence, and Boston and Worcester roads, are reduced to through passengers.

In the cost of the Camden and Amboy road, the cost of steamboats and some other matters are included, and the expenses and earnings of the boats at the ends of the road are also included in the statement.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1840.

With Remarks and Exemplifications by the Editor.

1. For a mode of *Oiling and Protecting Mill Spindles from dirt;* Jesse Hubbard, Watertown, Connecticut, April 8.

A collar attached to the upper side of the bush, fits into a groove in the under side of the driver, so that neither meal nor any kind of dirt can reach the spindles; for this purpose the middle part of the driver is made larger than usual to admit of forming a groove of sufficient diameter to receive the collar on the bush, and of course of greater diameter than the spindle. An oil hole, or tube, passes down through the whole length of the damsel, the bail and the driver; so as to discharge the oil where the spindle bears against the bush.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the mode of protecting the spindle of the mill from meal and dirt, by means of the protection collar and groove, and of oiling the spindles by means of a hole through the damsel, bail and driver, as specified." In all of which there is but little novelty, the same end having been before attained by means very nearly resembling that which is the subject of the foregoing patent.

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2. For improvements in the machine for *Making Bricks from Dry Clay;* Samuel Talbot, Richmond, Henrico county, Virginia, April 8.

Three, or more, moulds are made, in depth greater than the thick-

ness of the brick when pressed, and placed horizontally. The pistons for pressing are attached to a plate which is suspended by connecting rods to one end of a lever, and the plate is kept parallel with the surface of the moulds by means of two guide rods. The bottoms of the moulds, or "dischargers," are made similar to the pistons, and from the bottom of the plate, to which they are attached, descends a rod which answers as a guide to the motion of the plate, the lower end of which rod is connected to one end of a lever, passing under the machine. There is a table on each side of, and on a level with, the top of the moulds on which slides a discharger, which is simply a box without top or bottom, made to slide accurately by means of guides on each side, and this is connected by a rod to one end of a lever which vibrates horizontally, being actuated by cams on each side of a wheel acting on the other end of the lever which is forked for that purpose. The charger contains a sufficient quantity of dry clay for forming three bricks; when the charger is pushed over the moulds the clay drops into them, and it is then withdrawn. The pistons descend, press the brick, and the dischargers, or bottoms of the mould, then force up the bricks which carry up the pistons with them.

The lever which works the pistons, and that which works the dischargers are both operated by cams on the shaft of the cam wheel which works the charger.

The claim is to "the mode of producing the pressure on the pistons, by means of the lever operated by the cam, in combination with the mode of operating the dischargers; and also in combination with the foregoing, the mode of operating the box, or charger, and removing the bricks by the same."

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3. For an improvement in the manner of constructing *Stoves for Heating Apartments;* John Scott, Philadelphia, Pennsylvania, April 8.

This stove has an upright furnace, on the top of which is placed a drum, the upper part of the furnace passing through the cylindrical part of the drum and projecting some distance within it. The furnace is surrounded by a casing provided with holes for the admission of cold air which circulates around the furnace, becomes highly heated, and passes into the drum, through openings in which it is discharged into the room. A door is made in the cylindrical part of the drum for the supply of coal, which is thrown into a hopper. This hopper is connected with the furnace by a pipe, and a sliding valve is placed at the junction of the pipe and hopper, so that by closing the valve the coal can be thrown into the hopper without allowing the gas and dust to escape into the room; after the door has been closed the valve is opened and the coal falls into the furnace. A pipe passes through one end of the hopper and one end of the drum into the chimney flue. The object, as stated by the patentee, is to increase the radiating surface; to radiate the heat downwards so as to warm the feet of the persons sitting near, and to prevent the entrance of dust and dirt into the room. The patentee says, "I claim as my invention in the above

described stove, the manner in which I have combined and arranged the hopper, the drum and the furnace, as described."

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4. For a *Self Regulating and Oiling Mill Bush;* Samuel Moore, Borough of Chambersburg, Franklin county, Pennsylvania, April 8.

The exterior case of the bush is made of cast iron, is hollow, in form of a cross, and is let into the stone; through the centre of this case passes the mill spindle, the collar of which works between, and is sustained by, four brass boxes, one in each arm of the cross. These boxes are hollow and have two concave faces, so that when one is worn the other can be used by turning the box. The oil is supplied by means of a wick, or other fibrous material, which dips into the oil contained in the boxes, passes through a hole in the upper part of said boxes, and is brought into contact with the collar of the spindle, thus supplying the oil by capillary attraction. The boxes are borne up against the spindle by means of a spring acting on the back of each; and the tension of the spring is regulated by a nut working on a screw attached to the end of each arm of the cross, and passing loosely through a hole in the middle of the spring. The claim is to the manner in which the double faced brass boxes, or oil cups, are arranged and combined with the nuts, studs, and springs, so as to operate upon the spindle in the manner described.

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5. For an improvement in the manner of constructing the *Chairs for Railroads;* William Dripps, Coatsville, Chester county, Pennsylvania, April 8.

(See specification.)

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6. For an improved *Combined Mouldboard Plough;* Jonathan Knodle, Bakersville, Washington county, Maryland, April 8.

The disclaimer and claim accompanying the specification of this patent, will give a sufficiently clear idea of this improvement, viz: "I am aware that two or more ploughs have been combined together in the same frame, and I do not therefore make any claim to a combination as heretofore made. But what I do claim is the using of several mouldboards of cast-iron, of the ordinary construction of such mouldboards, but without land-sides; and the so arranging said mouldboards as that the point of either of those in the rear shall follow that which precedes it within the width of its furrow slice, in the manner and for the purpose herein set forth."

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7. For improvements in *Guns, Pistols, and other Fire Arms;* George Stocker and Joseph Bently, Birmingham, England, April 8, 1841.

There are three items claimed as improvements in this patent. The first is an explosion chamber within the breech, or solid "break-off," so that what flies off in the explosion of the cap shall not escape from said chamber. It is applied to guns in which the nipple is placed in

the back of the breech, the axis of the nipple being in a line with the axis of the barrel. This chamber is covered by a hinged plate which can be opened to place the cap on the nipple, &c. The second consists in a peculiar construction of the cock, which passes through the bottom plate and forms a handle in front of the trigger, and within the guard, the pins on which the cock works passing through two cheeks projecting from the trigger plate. To cock the gun, the lever of the cock is pushed towards the muzzle, and in a direction contrary to that of the motion of the trigger in discharging the gun. The third claim is to a mode of connecting the break-off, and the cock, and trigger plate, by means of a screw which passes through the break-off and screws into a piece of metal that projects from the inner side of the cock and trigger plate, thus embracing the stock. The trigger plate is provided with the usual screws in addition to that described.

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8. For improvements on *Harness for a Draft Horse;* Abel Post, Henrietta, Monroe county, New York, April 8.

These improvements are on that kind of harness in which the horse pulls by a strap passing around the breast, instead of by the collar around the neck, and consists simply, as the inventor states, "in forming a clasp, or hook, in the front of a *common breast collar* so that it can be separated there, to be taken off the horse; and also in substituting hames and pads in the place of the usual neck strap in the common English breast collar, so as to make the holding back easy for a horse." The claim is confined to the two devices above named.

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9. For improvements on the *Platform Balance;* Chauncey Crain and Evert L. Wemple, Madison, New York, April 8.

The rod which connects the platform lever with the steelyard beam is jointed, near its upper end, to a horizontal lever running under and jointed to the frame work of the steelyard. This lever is provided with a sliding weight regulated by a thumb screw passing through it and working in two pendants. By screwing the weight nearer to, or farther from, the connecting rod, the balance can be adjusted with the greatest accuracy. The same thing has been effected heretofore by having such a sliding weight attached to the steelyard beam.

Another improvement claimed is in substituting for the notches on the steelyard beam, a sliding clasp to which the weight is suspended. This clasp straddles the beam, and has two pointers, one on each side, to indicate the amount of weight.

The patentees say, "what we claim as our invention, and desire to secure by letters patent, is the method of balancing the levers by means of the weight suspended from the lever, between the pendants, and adjusted by the screw, as described. We claim also, the providing of the graduated lever with a clasp to which the movable weight is attached, with pointers to indicate, by the lines on the lever, the amount of weight on the platform."

10. For constructing and affixing the *Ribs of Cotton Gins;* Asa Copeland, Jr., Bridgewater, Plymouth county, Massachusetts, April 8. (See specification.)

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11. For improvements in machinery for operating the friction *Brakes of Railroad Cars;* John L. Clarke, Nashua, Hillsborough county, New Hampshire, April 11.

The brakes are of the usual construction, and are worked by a lever, one end of which is attached to the middle of the rod that runs across the car frame from one set of brakes to the other; the other end being attached to a double set of toggle joint levers suspended from the frame of the car. As the double toggle spreads, it relieves the brakes, and when it is straightened it forces them against the wheels. This working of the double toggle joint levers is effected by a sliding rod running through the whole length of the car and provided with two flanches or collars, one on each side, so that when the rod slides one way one of the flanches acts on one of the toggle joint levers and straightens it, and when it slides the other way the other flanch acts on the other toggle. The length of the rod in each car is so regulated that the bumpers can come together without bringing the ends of the rods into contact; but when the rod of the tender is forced back by the attendant, which is effected by a lever attached to the rod and passing through the floor, and the motion of the tender is arrested by the brakes, it comes in contact with the rod in the next car and forces it back, and so on from car to car until the whole train is affected. The forcing of the rod back carries the brakes up to the wheels and thus arrests the motion of the cars. The brake of the tender is worked in the usual way, and is so arranged as that it also can be worked by the arrangement before described. In this case the toggle used on the tender is single, and is embraced by a collar and slides freely on the rod, which is provided with a catch-dog hinged to it, and when the rod is forced back far enough the catch of the lever embraces the sliding collar and brings the toggle into play. The brakes can be acted upon either by a lever worked by the fireman or attendant, or by the momentum of the cars.

Claim.—"First, I claim arresting or retarding the progress of cars while in motion on a railway by a combination of rods connected with the friction brakes, by the intervention of toggles or progressive levers, transverse beam, or other suitable machinery, the whole arranged and operating by the momentum or power applied to the lever, substantially in the manner and on the principles herein described. Second, the method of connecting the rod of the tender and toggle by means of the combination of machinery, consisting of the dog, or catch, attached to the rod, piece of metal (sliding collar) shaped and arranged together, and acting in connexion with the levers, substantially as above described, for the purpose of operating the brakes by the momentum of the cars whenever the same may be necessary or desirable."

12. For a machine for *Cleansing and Washing Yarn and other Substances;* Sands Olcott, city of Philadelphia, Pennsylvania, April 11.

This machine consists of a series of fluted rollers, moving with equal velocity. The upper one of each set works within flanches on the under one, and receives motion from it by being pressed down in a manner similar to that of the draw rollers of a spinning machine. The yarn, or other substance, to be washed and cleansed is made into a skein or endless belt; a portion of it hangs in water, or other detergent, contained in a vat, whilst the rest is passing under the series of rollers; a roller is placed at the bottom of the vat, and around this the skein passes for the purpose of properly guiding it.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the construction of a machine for washing yarn and other substances by means of a series of pairs of fluted rollers, with flanches on one of each pair, in combination with the reservoir and trough, so that an endless skein can be passed continually through them, and at the same time be passing through the water or other liquid, for washing, as herein described."

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13. For a machine for *Reducing the Fibres of Flax and Hemp;* Sands Olcott, city of Philadelphia, Pennsylvania, April 11.

A cylinder provided with a series of circular saws, or teeth, like those of a cotton gin, revolves in a frame and has a revolving fan below it to clean the teeth of the saws. The fibres to be reduced are carried up to the saws by a series of cords which pass around a roller at each end of the frame and under a grooved roller above the saws. The last named roller has a groove for each saw and one for each cord. The claim is to "the combination of the gang of saws, or rows of teeth, on a cylinder, with the arrangement of cords and rollers for holding, guiding and working the flax and hemp, in the manner described."

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14. For a *Floating Swing Bridge;* John N. Vrooman, Danube, Herkimer county, New York, April 15.

One end of this bridge is attached, by means of a *pivot*, to a frame on the side of a canal, or other stream, whilst its other end is attached to a scow, boat, or buoy, and floats upon the water. When the bridge is floated into place for passage, it rises several inches above the frame built out from the bank. Why it is made to float so high is not stated, but we suppose that it is intended to provide against the inconvenience of low water, and to prevent the friction which would be consequent upon the dragging of such a weight on to the frame which receives it. It is stated that the bridge can be raised, in case of low water, by means of slides, screws, &c., by arrangements well known to mechanics, and which, therefore, need not be described. The swinging end of the bridge is connected with both shores, by means of ropes, so arranged that it can be opened from either; and it

is also provided with a latch to prevent it from swinging open except when desired. The ropes are so connected with the latch that it can be disengaged therefrom from the off shore.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the employment of a boat, scow, float, or buoy, for the purpose of sustaining the swinging end of the bridge in the manner described. I also claim the arrangement of ropes, or chains, by which the bridge can be opened or closed from either side of the canal or stream, as described, and in combination therewith the latch for retaining the bridge in its place when thrown back."

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15. For *Oiling Horizontal Shafts and Axles;* Hiram M. Smith, city of Richmond, Virginia, April 15.

Oil is to be supplied to the gudgeon, or gudgeons, of a shaft by means of a wheel which revolves in a reservoir of this fluid attached to the lower box of the gudgeon. The wheel has its bearings in a sliding frame, resting upon a spring which bears it up to the gudgeon of the shaft. The lower box being pierced to allow the wheel to come in contact with the gudgeon; this box is provided with a gutter on each side of the gudgeon to catch the oil, which runs back into the reservoir through a hole made for that purpose. A scraper, or wiper, is attached to the sliding frame of the wheel to wipe off, or remove, the surplus oil.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the wheel working in an oil cup, and a sliding frame, or gate, acted upon by a spring which adapts it to any irregularity of height the bearing is subject to, as herein described. I disclaim it as a friction roller, as I do not intend it to support the bearing, but merely to act as an oiler or feeder. I also claim the wiper and the gutters on each side of the bearing in combination with the wheel as herein described."

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16. For an improvement in *Swages or Dies for making Screw Augers;* William Field, Pawtucket, Providence county, Rhode Island, April 15.

There are two swages, or dies, which when put together form the matrix of a little more than the half of one twist of the augur. The metal is prepared by making it into a flat bar on the part to be twisted, with a round part above the twist. The swages are worked in any manner known to workmen, such as tilt or trip hammers, &c. That part of the swage or die which forms the thread in one half of said die, should extend some distance into the other half. As the dies are operated upon, the bar of metal should be turned round. It will be obvious that the flat bar will thus be twisted section by section until the whole twist be completed. The claim is to the forming the twist in screw augurs by means of the swages or dies constructed as described.

17. For an improvement in the *Cheese Press;* Rufus Porter, Billerica, Middlesex county, Massachusetts, April 15.

The design in this press is to produce the required pressure by the weight of the cheese which is being pressed. The board upon which the cheese is placed, and the one above it which gives the pressure, are attached to end pieces that slide upon each other and on the vertical sides or posts of the main frame. The side pieces of the boards slide upon each other to allow them to come close together, or to recede from each other. At each side two levers are arranged with their fulcra in the side pieces of the upper board, and act against the side pieces of the bottom board. These levers are bent upwards, and are united at their upper ends by the axis of a roller which bears against the outer edge of the posts of the frame that are swelled out, being much wider at the base than at the top. Thus it will be seen that when the cheese or other weight is placed on the bottom board it descends, and as it descends the rollers on the ends of the double levers are forced out by the swell on the outer edge of the posts, throwing out the upper ends of the levers, and thus compelling the two boards to approach each other. The claim is confined to "the mode of producing a pressure by means of the double levers, friction rollers, and swelled posts, as described." There have been two or three patents previously granted for causing the cheese to be pressed to operate by its own weight in producing the pressure, but under an arrangement of the respective parts different from that above described.

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18. For an improvement in the manner of constructing *Bee-Hives;* Martin Engel, of the borough of Easton, Pennsylvania, April 15.

The specification of this patent is of considerable length, and the drawings numerous; and as nothing short of a full description and representation would give any adequate idea of the construction of this hive, we must forego the attempt in the narrow limits of a notice.

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19. For improvements in *Tailors' Measuring Instruments;* William I. Lemmond, Lancasterville, South Carolina, April 18.

As we are not particularly acquainted with the art of measuring the human figure for the purpose of cutting garments, we will dismiss this article by quoting that part of the specification which expresses the nature of the invention, together with the claim, viz: "The nature of my invention consists in the combination of a horizontal graduated sliding strap, having graduated vertical sliding straps upon it, with tape measures attached to them with a graduated vertical strap. And also the combination of a graduated horizontal strap, having vertical sliding pieces with tape measures attached to them, with the vertical strap."

"What I claim as my invention, and which I desire to secure by letters patent, consists in the combination of the horizontal graduated sliding strap, having graduated vertical sliding straps upon it with

tape measures attached to them, with the graduated vertical strap; and also the combination of the graduated horizontal strap, having vertical sliding pieces with tape measures attached to them, with the vertical strap."

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20. For a method of *Measuring the Body and Drafting Garments;* Isaiah J. Hendrix, Troy, Rensselaer county, New York, April 18.

The remarks made upon the preceding patent will apply to this. The patentee says—"The nature of my invention consists in the use of a flexible square applied to the body of the person to be measured, and also in the use of a protractor likewise applied to the body of the person to be measured, each and together furnishing, when properly applied, sufficient data to govern the mechanic in the correct cutting of a garment more easily and correctly to fit the varieties of form and persons, enabling the mechanic to take measures and note them down so that they can be applied to the cloth precisely as they are taken on the person, as the skilful surveyor delineates a map from the minutes which he has taken of the survey of an uneven surface." "What I claim as my invention and desire to secure by letters patent, is the mode of obtaining the backward or forward location of the shoulder strap and pitch of the shoulder seam by means of a flexible square and protractor, applied and used in the manner described."

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21. For improvements in the *Construction of Railroads;* James Herron, Baltimore, Maryland, April 18.

The first improvement is fully explained in the first section of the claim, which is in the following words, viz:—"What I claim as my invention, and desire to secure by letters patent, is, 1st. Placing the sills in the formation of a railway, so that they will cross each other in lines diagonal to the rails; and uniting them with each other and with the rails, so that they become struts and tie braces to the track, substantially, as described. And whereas said brace sills may be variously combined with each other, and with cross sills, and may be made to support an iron rail without the intervention of the timber string pieces; and may also, like common sills, be placed on a 'mud sill.' I distinctly claim to be the inventor of the *braced sill* or *latticed construction* of railway tracks under the modifications set forth, together with such variations thereof as may produce a like result by means substantially the same. I thus by the union in one, to an indefinite extent, of such materials as those that usually compose railway tracks, obtain by a united framing a more extensive and uniform bearing on the soil than the individual parts would have; all other railways having to depend upon the uniformity of soil, or artificial road-beds, for their evenness of surface. Whereas my railway track is independent in its formation of the soil on which it rests."

The second improvement consists in a mode of uniting or scarfing the string pieces, so that where the ends are put together they cannot

separate from each other except lengthwise, and the claim is to this peculiar mode of scarfing, which could not be understood without diagrams. The third improvement is for a mode of holding the iron rails by means of a spring, which presses the ends of two rails against the chair to prevent vibration, and at the same time permits them to slide lengthwise when expanding or contracting, which is effected by making the bolt which passes through the rail and chair with a double spring instead of a head, which thus holds the ends of the two rails; or by making a wrought iron chair, with ears on each side, that are bent over the web or seat of the rails, when laying them down. The claim is to the "method of evenly joining, and holding railway bars by means of a *metallic spring pressure*, so as to permit the contractile and expansive motion of the railway bar, whether said spring pressure operates by means of my malleable iron chairs, or as it may be variously modified and united with cast iron chairs, as described. The application of a spring to the rail for the purpose described being in itself new, and as said spring may be variously applied for producing the intended effect, it is to be understood that I claim the employment of a spring under the various modifications thereof described, and whenever it operates upon the principle and produces the effect in the manner set forth."

The fourth and last improvement is for a mode of holding the iron rails at the "middle of their lengths" by means of a piece of iron lying across the string, having two wrought iron ears which are bent over the web or base of the T rail, and being attached to the string by means of an iron strap screwed to the ends thereof, and passing under the string, or keyed under it. Or effecting the same thing by key bolts passing through the strings and the web or base of the T rail, by which mode "the iron rail is made to support the scarf of the string pieces or to form a part of the splice." The claim is to the mode of holding the rails at the middle of their lengths, as set forth.

We will only remark that the plan of construction proposed in this patent has been the subject of high commendation by some of our best practical engineers.

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22. For improved machinery for *Manufacturing stuffs in which the fibres of various materials are united with adhesive substances;* Thomas R. Williams, a citizen of the United States, now residing in England, April 24.

This invention consists of a new arrangement of machinery, by means of which all kinds of fibrous materials, such as cotton, silk, flax, hemp, tow, fur, wool, hair, &c. are combined, with adhesive compositions, into manufactured articles which may be applied to the purposes for which paper, pasteboard, millboard, papier maché, parchment, vellum, leather, woven fabrics, felt, floorcloth, tarpaulin and skins of animals are used.

A cylinder covered with wire gauze, &c. revolves in a case in which the fibres are suspended by a current of air, generated by a fan revolving in a case connected with the cylinder, which is so

arranged, by means of partitions, that the partial vacuum generated by the fan can only be supplied by the passage of air through the wire gauze covering of that half of the cylinder which, in its revolution, is above a horizontal line passing through the shaft. This current of air carries and deposites the fibres on the cylinder as it revolves, thus making a sheet, or batt, continuously, which is carried off between two pressing rollers. It is then carried between two rollers which apply the adhesive compound. The under roller revolves in a trough containing the melted compound, and carries up a sufficient quantity to apply to the under side of the batt, and the trough which applies the compound to the upper side is situated at the side of the upper roller so as to deliver the compound directly on to the batt. The rollers are kept hot by heaters, or in any other manner, and the upper one is weighted so as to press out the surplus of the composition and compress the batt.

The adhesive composition used in this part of the apparatus may be made of about three parts of pitch or rosin, with about one part of tar, to which add perhaps a thirtieth of oil or tallow, but the proportions necessarily vary for the different purposes for which it may be intended."

After the batt or sheet has passed through this apparatus, it may be cut and dried for use, or be carried through another composition consisting of weak size, mixed with paste and clay in different proportions, contained in a vat, and this is to be done by passing it over and under a series of rollers immersed in the compound, and then between two pressing rollers.

"The patentee says:—"I do not claim the forming of a batt or sheet from fibrous materials in the manner set forth, nor do I claim the machinery employed for the saturating of such a batt or sheet of fibrous materials with resinous and other substances; but what I do claim as of my invention and desire to secure by letters patent, is the so combining and arranging the machinery employed substantially in the manner herein set forth, as that the processes of forming the batt and of saturating the same with the different compounds shall be simultaneously and consecutively effected so as to form sheets or lengths of fibrous materials applicable to various purposes."

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23. For improvements in the machine for *Crushing Hard Substances;* James Rowe, Athens, Limestone county, Alabama, April 24.

This patent has been granted for alleged improvements on a machine long known, and used for crushing lime and other substances in preparing mortar, cement, &c., which machine consists of two wheels working on the ends of a beam attached to a vertical shaft, the wheels running in a circular trough surrounding the shaft.

The first improvement consists in a mode or modes by which the turning of the wheels is insured, either by making indentations on the peripheries of the wheels, into which fit knobs or projections made in the bottom of the trough, or by placing a cog-wheel on the shaft of each crushing wheel, which mashes into cogs made on the

outside of the trough. The second improvement is for applying weight to the wheels by balancing the beam in a mortise passing through the shaft, and having the shaft to rest upon the pin on which the beam is balanced, so that any weight applied to the upper gudgeon of the shaft by a weighted lever will of necessity be transferred to the wheels, and cause them to crush substances which could not be affected simply by the weight of the wheels. The claim is, first, to the "mode of preventing the grinding" (or crushing) "wheels from slipping by means of the cog gearing, or by cross projections and indentations of the valley, (trough), together with cuts, cogs, or notches on the tread of the wheels. And second, to the method of applying the weight of the centre revolving shaft, or any additional weight which may be applied thereto, to the grinding, or crushing, wheels by making the shaft bear upon the vibrating (balance) beam to which the wheels are attached, as described."

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24. For improvements in the *Power Loom*, so as to adapt it to the weaving of counterpanes; Erastus B. Bigelow, Lancaster, Worcester county, Massachusetts, April 24.

(See specification.)

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25. For *Constructing and Cording Bedsteads;* Martin Engel, of the Borough of Easton, Northampton county, Pennsylvania, April 24.

This bedstead is put together with round tenons, those on the end rails being longer than usual, and those on the side rails being provided with a pin projecting from the end of each, which passes into a hole made in those of the end rails. The end rails are round, and inside of the foot rail there is a roller having its gudgeons working in the side rails; and on the inside of the head rail there is another roller not provided with gudgeons but working freely within the side rails; to this roller a windlass is connected by means of straps which wind around it. The cord is in one piece, and one of its ends is attached to the roller inside of the head rail; from thence it passes over the head rail, then over the foot rail, around the roller within the foot rail, back over the foot rail, over the head rail, and around the roller within the head rail, and so on until the whole of the cord is taken up and the space within the rails corded. The cord is tightened by turning the windlass which winds up the straps, connecting it with the roller, next to the head rail, and draws it up, and thereby stretches the cord. The claim is to the above manner of connecting the rails, and to the mode of cording.

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26. For an improved mode of making *Metallic Heddles for Looms;* Charles Strong, Hartford, Windsor county, Vermont, April 24.

These heddles are made of narrow strips of tinned sheet iron, or other metal, having a hole made at each end to slip on to wires at the top and bottom of the frame. The eyelet hole is made by bending out the metal and then taking another piece of the same material

longer than the bent part, bent in a similar manner, and soldering the two together above and below the bent parts, thus leaving an opening sufficiently large to receive the thread. The selvage heddles are made in the same manner except that the eyelet holes are larger. For making highly sleyed cloths the heddles are arranged in two rows so as to bring the thread closer together, and for that purpose there are two wires at the top, and two at the bottom of the heddle frame, that the set of heddles on one wire shall come in a line with the space between the other set. The patentee disclaims the mere making of metallic heddles, and confines his claim to "the method of making the eyelet holes in the common and listing heddles, as described; and also to the method of arranging the metallic heddles in two rows instead of one, by which arrangement higher sleyed cloths may be woven by the metallic heddles than without that arrangement, as described."

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27. For improvements in the machinery for *Making Rivets;* Oliver Edes and Andrew Holmes, Braintree, Norfolk county, Massachusetts, April 24.

The claim refers throughout to the drawings and could not be understood without them, we will therefore merely attempt to give a general idea of the improvements claimed.

The first improvement consists in the construction of the cutting apparatus, the dies of which are semi-circular, so that in the operation of cutting the wire shall not be flattened, there being a standard, or gauge, against which the wire is forced by the operator to regulate the length of the rivet. The second is in the combination of the moving cutter, which separates the blank from the rod, with a spring arm for "pinching, or nipping, the piece of wire separated by the cutters, and conveying it downwards to the aperture" of the leading apparatus; and also in the arrangement of parts which withdraw the arm above mentioned from the blank after it has been carried to the heading apparatus. The third is in the combination of levers, &c., for forcing, or pushing, out the rivet from the aperture after the heading machinery has performed its office.

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28. For a *Movable Loading Muzzle for Rifles;* Alvan Clark, Cambridge, Middlesex county, Massachusetts, April 24.

The object of this improvement is to facilitate the loading of the rifle and to preserve the calibre of precisely the same diameter to the very point of delivery of the ball, and this is to be effected by means of what the inventor calls a "movable loading muzzle," which is put on to the end of the barrel for loading, and removed when the rifle is to be fired. The bore of this loading muzzle, where it meets the barrel, is of the same diameter with it, and is enlarged towards the mouth so as to receive the ball with ease, and gradually prepare it to be received by the barrel. The rifling of the barrel and muzzle should correspond. The muzzle may be fitted on by means of pins projecting

from it and fitting into holes made for that purpose in the end of the barrel. The claim is confined to this device.

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29. For improvements in the *Braiding Machine*, by which it is adapted to the braiding of Manilla or Sisal hemp; Elisha Fitzgerald, New York city, April 24.

This patent was granted for improvements on the ordinary braiding machine, in which the "bobbin carrier" travel a serpentine course around what is called a "pot." In this machine the double serpentine course only reaches around two thirds of the circumference of the pot, and after the bobbins have traveled to one end they return, and thus go from end to end interlacing the fibres or threads, and the improvements claimed consist, first, of two draw rollers, one of which has a continuous motion and the other pressing upon and receiving motion from it, which rollers receive and draw the braid, as it is made, from an eye-plate, so called because it has an eye through which the braid passes; this is placed above the machine, but in a line with the vertical axis of the pot. As the threads pass from the bobbins to the eye of the eye-plate, they, by being carried around and interlacing, form the braid; but to insure the proper formation of the selvages or edges of the braid, a circular guide plate is used on each side of the eye-plate, the centre of each of which is in a line with the eye and the centre of the circle around which the bobbins travel, in returning after they have reached the end of their circuit. The threads are carried around these guide plates and insure the proper formation of the selvages.

The claim is confined to the employment of the circular guide plates, and to the combination of the draw rollers with the spools, guide plates, and eye-plates, as described.

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30. For a *Corn Sheller;* Peter A. Gladwin, Chester, Middlesex county, Connecticut, April 24.

This corn sheller is an improvement on one patented to Lester E. Denison, and noticed in vol. xxvi of this Journal, page 160; it consists of what the patentee terms a "carrying cylinder," made of strips attached to two heads, the spaces between the strips are sufficiently large to receive an ear of corn of the largest size. A spring bottom is placed in each of these spaces for the purpose of pressing the ears of corn contained in them, against the concave, which consists of a series of shelling cylinders. As the carrying cylinder revolves, it brings each ear against the successive shelling cylinders. The shelling cylinders are made to revolve by a cog wheel on the shaft of the carrying cylinder which mashes into a pinion on the shaft of each of the shelling cylinders.

The claim is to "the forming of the concave with a number of shelling rollers arranged in the manner described, and also to the arrangement of the spring beds in the carrying cylinder instead of the concave."

In the machine patented to Lester E. Denison, a large shelling

cylinder revolves within the carrying cylinder, and the ears are forced against it by the spring concave.

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31. For an improvement in *Steam Boilers;* John Penniman, city of Baltimore, Maryland, April 24.

We will merely quote the claim appended to the specification as it gives a sufficiently clear idea of the improvement to bring it within the comprehension of any one, viz: "Having thus fully described the nature of my improvement, and the manner in which I carry the same into operation, what I claim therein as my invention, and desire to secure by letters patent, is the placing a series of circulating tubes on the front plate of the boiler, in such a manner as that they shall, at their lower ends, communicate with the water in the lower part of the boiler, and at their upper ends with the water in said boiler a little below the water line, whilst they are, along their whole length, exposed to the direct action of the heat in the fire box, in the manner and for the purpose above set forth."

In pointing out the effect produced by thus placing the tubes, the patentee says, "as these tubes open below into the lower part of the boiler, and at their upper ends into the upper part of it, below the water line, the water which will become highly heated in the lower parts of the tubes, will naturally ascend, and that with considerable rapidity, towards the upper part, where they will give out their steam, and by the action of the water circulating through them, they will necessarily draw the water in the lower part of the boiler towards them, and effect the required circulation."

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32. For a *Smut Machine;* Jacob Russel, Jenner Township, Somerset county, Pennsylvania, April 24.

Two revolving beaters, each consisting of eight perforated rings on a shaft, are placed in a case one above the other, their shafts laying horizontally. The case is made of perforated metal semi-cylindrical at top and bottom, and the two semi-cylindrical parts connected by vertical sides.

The patentee says, "I do not claim the mode of arranging the revolving beaters, the one set over the other, as herein set forth; but what I claim is the arranging them in a case formed with a double concave so that each series of fans, or beaters, shall revolve in a separate concave, as described."

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33. For improvements in the *Duplex Escapement for Watches;* Charles Edward Jacot des Combes, Baltimore, Maryland, April 30.

The patentee says, "my improvements consist of a new and improved mode of constructing the escapement, called by me the American Duplex Escapement, and also of an improved mode of rendering the movement of the seconds independent." We will not attempt a sketch of the construction of these improvements, as this could not be

done to any advantage without drawings; the claim refers throughout to the drawings, and could not be understood without them.

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34. For improvements in *Stoves for Heating Apartments;* William Frazier, city of Brooklyn, New York, April 30.

A cylindrical drum is placed alongside of the stove and communicating with it by two pipes one above and the other below the grate. The drum, or radiator, is divided into four parts by two partitions at right angles to each other, one of them extending from the top to near the bottom, and the other from the bottom to near the top; by this arrangement it will be seen that when the draft is carried through the drum, or radiator, it passes down one of the divisions under the partition, up and over the second, down the third, and under the partition to the fourth, from which it passes out through the pipe into another such radiator, or into the chimney. In each of the divisions is placed a pipe opening into the room at top and bottom for the air of the room to circulate through. The claim is to the combination of the partitions and pipes in the drum, or radiator. The number of drums, or radiators, can be increased at pleasure.

This stove resembles, and is designed as an improvement on, that patented by Denison Olmsted, of New Haven, Connecticut, on the 5th of November, 1834, a description of which will be found in vol. xv, of this Journal, page 407.

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35. For an apparatus for the *Treatment of Club Foot;* John B. Brown, M. D., Boston, Massachusetts, April 30.

The foot board of this apparatus is made in two parts, united by a joint so that the forward part, or that which receives the front part of the foot, can be turned to the right or left, by means of a screw in the heel part, the threads of which take into cogs on a sector attached to the forward part. "The remaining portions of the apparatus are similar to that heretofore used, with the exception of the upright standard," which is so constructed that it can be applied to legs of different lengths, by having the part of the standard to which the strap is attached made separate from the standard, and provided with a slot so as to attach it to the main part of the standard by screws, the slot allowing it to slide out or in, and thus to regulate the length. The patentee says that in some instances he connects the heels and toes of the two feet by means of yokes, which consist of two metal rods having their ends turned at right angles and fitting in a hole made in a metal ear attached to the heel and toe of the apparatus, so that by having one of these rods, or yokes, connecting the heels and another the toes of the two feet, the length of each being properly regulated, the "patient will be enabled to walk by taking short steps, until the muscles become accustomed to their new action, and the bones acquire their relative and natural position. When one foot only is deformed, a shoe is applied to the well foot with ears at the toe and heel for the insertion of the yokes."

The claim is confined to the mode of constructing the foot board in two parts, and to the manner of yoking the two feet together.

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36. For an improved mode of constructing the feeding part of *Straw Cutters;* Israel W. Groff, Lampeter Township, Lancaster county, Pennsylvania, April 30.

On the crank shaft which is placed across the machine under the straw box and about midway between the ends of the machine, there are two double cams at right angles to each other; one of them works a lever which is connected to, and operates, a dog, or hand, which is drawn up by a spiral spring, so as to make it catch on the underside of a ratchet wheel on the upper feed roller. A spiral spring keeps the lever against the cam. The hand or dog which works the ratchet wheel on the under feed roller is hinged to the first mentioned dog, or hand, so that the two feed rollers are operated together. The second cam actuates a lever which works the bearer by means of a rod which connects the two. The bearer is a block which rests upon the straw in front of the feed rollers, it is suspended to the ends of two arms projecting from a shaft, which has another arm at one end projecting from it at right angles to the two first mentioned, and to this last is jointed the rod which connects with the lever worked by the second cam. By this arrangement it will be seen that as the cam moves the lever the bearer will work up and down. The bearer and the upper feed roller have their bearings in an iron frame, the back end of which is jointed to the straw box. A spiral spring draws down this frame so as to press the upper feed roller and bearer on the straw. The cams are so regulated that before the feed rollers are turned the bearer is lifted up to allow the straw to be forced forward, and as soon as this has been effected the bearer is forced down again to press the straw preparatory to cutting. The claim is confined to the foregoing device for working the feed rollers, in combination with the bearer.

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37. For an apparatus for *Adjusting the Grinding Surfaces of Artificial Teeth;* James Cameron, city of Philadelphia, Pennsylvania, April 30.

The teeth when prepared are attached to two plates, the upper one for the teeth of the upper jaw, and the lower one for the teeth of the lower jaw. These plates are connected to a vertical rod on a standard, in a manner similar to that of the sliding reading lamp and its stand. The upper plate does not slide up and down, but can be drawn in and out, and set in an oblique position, and there retained by a set screw which passes through the vertical rod and acts on the round stem of the plate. The lower plate slides up and down on the rod and can be fixed at any point by a set screw. Like the upper one, it can receive any oblique position and is hinged so as to imitate the working of the under jaw. A rod attached to a slide may be placed at any point below it, to answer as a rest. By means of these plates

and adjustments the grinding surfaces of artificial teeth can be regulated and adjusted with the greatest nicety.

As the claim refers to the drawings, it would be useless to give it here, and we will therefore merely state that it is confined to the combination of the plates and standard rod, the rest for the lower plate and to the mode of regulating the motion of the lower plate.

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38. For improvements in the machine for *Picking and Opening Wool, Cotton, &c.;* George C. Kellogg and Phineas Gillett, New Hartford, Litchfield county, Connecticut, April 30.

The first improvement is in the mode of feeding the wool, or other fibrous substances, into the picking machine, and consists of a feeder roller with teeth all over its surface, which revolves nearly in contact with a concave, or shell, the lower edge of which receives the wool, cotton, &c., from the creeper cloth, where it is taken by the teeth of the feeder and carried up to the upper edge of the concave, or shell, where it is caught by the teeth of the picker. The upper edge of the shell extends up to a level with the axis of the feeder and whence it is turned down and forms a concave for the picker. The second improvement is in the mode of attaching the teeth to the lags of the picker cylinder by inserting them in holes made in the lags, and then securing them by means of screws, staples, or bolts, that pass through the lags at right angles to, and embrace, the teeth. By loosening the screw staples, or bolts, the teeth can be set or removed and replaced at pleasure.

The claim is to the combination of the feeder and shell, and to their combination with the picker cylinder; and also to the method of holding and setting the teeth in the lags by means of the screw staples or bolts, as described.

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39. For an improved *Process in the Art of Tanning Leather;* Richard T. Downing and George D. Smith, Philadelphia, Pennsylvania, April 30.

(See Specification.)

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40. For a *Seed Planter;* Lorenzo and Samuel H. Bachelder, Hampstead, Rockingham county, New Hampshire, April 30.

This patent is taken for an improvement in those parts of a seed planter which open the ground and conduct the seed from the dropping wheel to the furrow prepared for it. The dropping tube, or conducting pipe, is made in the back part of the coulter, and on each side of the coulter there is a wing, or share, and these two shares are united in front to a chisel-shaped projection, or nose. The under side of the double share is concave, and directly in front of the lower opening of the dropping tube there is a bar, or cross sill, running across the concavity for the purpose of smoothing the bottom of the furrow to receive the seed. The claim is to the combination of the coulter with

the share, nose, and bar, or cross sill, as described, and also to the combination of the dropping tube with the other parts named.

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41. For an improvement in *Fire Places to Prevent Smoking;* Horner Roberts, Delhi, Delaware county, New York, April 30.

The patentee says, "the nature of my invention consists of certain new and useful arrangements of curved and straight cast and wrought iron plates in and above the throat of the chimney by which the wind is prevented from blowing though the throat into the fire place and driving the smoke and fire into the room, and by which the draught is increased by the air becoming heated from said plates, and also said arrangement preventing an entrance of persons to the interior of the house through the chimney and fire place.

The form and arrangement of the plates could not be made intelligible without drawings. The claim is to the arrangement of the plates by which the effect specified is produced.

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42. For an improvement in the *Stump Extractor;* Frederick A. Stewart, Catherine, Chemung county, New York, April 30.

This patent was granted for an improvement on a stump extractor patented by Willard Foster, of Oswego, Tioga county, New York, on the 22nd of April, 1831, a notice of which will be found in the eighth volume of this Journal at page 167, and is merely for making the lever, to which the chain is attached, which passes around the stump, of two pieces, which are opened at the bottom to straddle the stump, they are joined together at the top, and are connected about midway by a cross piece; this is used in place of the single lever attached to a cross piece at the bottom, which rests on the ground by the side of the stump, as used by Foster. The objection alleged against Foster's is that from its peculiar construction when applied to a large stump, requiring the greatest amount of leverage, the foot of the lever has to be removed to a greater distance from the centre of the stump, thus decreasing the leverage, whereas when made as above, the lever can straddle the stump and its foot be placed as near the centre of the stump, as desired.

The claim is to "the construction of the lever as before described, so that the angle formed by the inclination of the lever and chain attached to the stump can be decreased at pleasure, independent of the size of the stump."

The patentee of the above is the owner of the patent granted to Willard Foster, and there are not, therefore, any interfering claims.

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43. For improvements in machinery for *Preparing and Spinning Flax and Hemp;* Moses Day, Roxbury, Suffolk county, Massachusetts, April 30.

The fibres of flax, or hemp, are prepared by means of teeth on three cylinders. The teeth are arranged in rows, each row attached

to a slide working within the cylinder, and passing through slots in the peripheries of said cylinders. The sets of teeth are projected beyond the surfaces of the cylinders during a portion of their circuit, and are drawn in during the remainder of their circuit, this is effected by having the ends of the slides, to which the teeth are attached, working in cam, or eccentric, grooves, made in plates at each end of the cylinders—the plates remaining permanent while the cylinders revolve. The fibres pass over the first cylinder, under the second, and over the third, where they are brought together to form the roving, or roping, and pass through a tube, or regulator, from whence the roving passes to the flyer to be spun. The tube, or, regulator, is connected by means of levers, and their appendages, to a latch which throws the cylinders in and out of gear, so that when the cylinders, or the preparative part of the machinery, supplies too much material, the roving becomes too large and moves the regulator which throws the preparative part of the machinery out of gear.

An improvement is claimed in the spinning part of this machine for the purpose of giving a back and forth motion to the spindle (the spindle being horizontal) to wind the yarn on the bobbin; this device consists of a single threaded screw on the spindle, which for this purpose passes out a considerable distance beyond the back of the flyer; there is also an arrangement of pullies and bands which could not be clearly understood without drawings, the claim to this part refers throughout to the drawings.

The claim is to "the combination of the revolving drums and several rows of teeth with the machinery within said drums for operating the several series of teeth, or metallic points, as described. The regulator as described, and the combination of the regulator with the several different series of teeth, formed as described, (those near the sides of the drums being shorter than those near the centre of the same,) which arrangement, in conjunction with the peculiar shape of the regulator, forms the roving. Also stopping the preparative part of the machinery by means of the regulator in combination" with the arrangement of levers, clutch, &c. And finally to the arrangement made for imparting a reciprocating rectilinear motion to the spindle.

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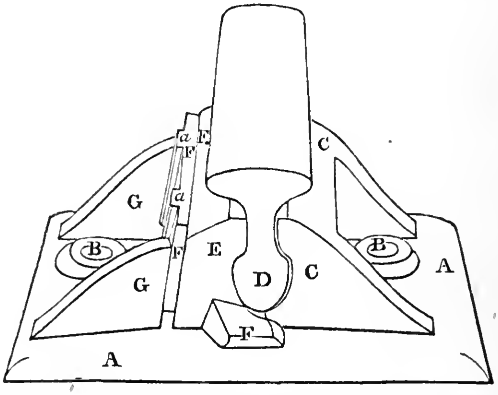
44. For a method of *Stiffening Rocket Staffs;* John W. Cochran, New York, April 30.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the method of stiffening rocket staffs by means of metallic stiffeners in the form of cylindrical metallic tubes, or with a cylindrical metallic tube having flanches, or with the metallic flanches, as above described." It is only necessary to say that wood is put upon the outside of the metallic part, indicated in the above claim, to complete the rocket staff.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for an Improvement in the manner of constructing the Chairs for Railroads. Granted to WILLIAM DRIPPS, *Coatsville, Chester county, Pennsylvania, April 8th,* 1840.

To all whom it may concern: Be it known that I William Dripps, of Coatsville, in the county of Chester, and state of Pennsylvania, have invented an improvement in the manner of constructing the chairs for sustaining and holding the edge rails for railroads; and I do hereby declare that the following is a full and exact description thereof:



The accompanying drawing gives a perspective view of my railroad chair, embracing a portion of a rail. A A, is the sole or basement of my chair, which may be bolted down by bolts passing through the holes B B, or fastened in any other way which may be preferred. C C, is a cheek cast solid with the sole A A, and so formed as to receive one half of the lower part of the rail D; the other half is embraced by the separate casting E E, which has a jog F, cast on each of its ends, which jogs embrace the lower part of the cheek C C, and prevent E E from moving laterally. When E E is dropped into its place, and made to embrace the rail, it is confined there by means of the wedge plate F F, one side of which bears against it, whilst the other side is supported by the cheek C C, cast solid with the sole A A. The wedge plate F F, has ledges *a a*, upon its back, to guide and keep it in place, and it may have a cross ledge to receive the end of a crow-bar when it is required to be raised. It will be seen that by this manner of constructing railroad chairs, the respective pieces by which the rail is held in place cannot possibly became loosened by the vibration of the rail, or from any other cause, as the wedge plate, which confines the whole, will always tighten itself by its own gravity, and will consequently keep the whole firmly in place.

Having thus fully described the manner in which I construct my railroad chair, and shown how the same operates in producing the

intended effect, what I claim therein as of my invention, and desire to secure by letters patent, is the particular combination of the respective parts thereof, constructed, formed, and operating substantially as set forth, that is to say, I claim the combination of the cheek piece C C, with the separate cheek piece or casting, E E, and the plate wedge F F, producing their combined effect in the manner described.

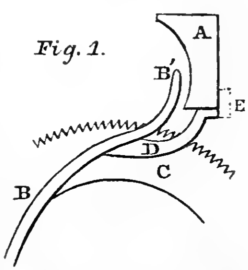
WILLIAM DRIPPS.

Specification of a Patent for constructing and affixing the Ribs of Cotton Gins. Granted to ASA COPELAND, JR., *Bridgewater, Massachusetts, April 8th,* 1840.

To all whom it may concern: Be it known that I Asa Copeland, Jr., of Bridgewater, in the county of Plymouth, and state of Massachusetts, have made certain improvements in the manner of constructing and affixing the ribs or grates of saw gins for ginning cotton, and I do hereby declare that the following is a full and exact description thereof:

In the saw gin as ordinarily constructed, the cotton is liable to collect in the spaces between the ribs and around them, above the point where the saws operate, thus choking or clogging the grate and preventing the rising and free escape of the fibres and seed therefrom. To obviate this inconvenience, instead of attaching the ribs by their upper ends directly to the part usually denominated the breast or grate fall, I in general extend a brace or arm out from near the upper ends of said ribs, by which to attach them to the breast in such a manner as that they shall stand out from said breast, and leave a free space of the fourth of an inch, more or less, for the escape of the cotton. The attachment may be made to the front, bottom, or back of the breast, and the mode in which this is effected will admit of much variation without departing from the general principle on which the improvement is founded.

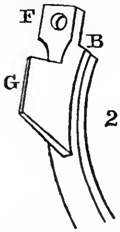
Fig. 1.



In the accompanying drawing, fig. 1 represents a section of the breast A, with a rib B, attached to it, C being one of the saws. D is a brace or arm extending out from the under side of the rib, and attached by a screw to the under side of the breast at E. I sometimes carry the end E up on the back side of the breast, and screw it to that part, as shown by the dotted lines, or it may be carried up on the front and there attached. The arm D may be round or flat where it leaves the rib B, and it should be made narrower than the rib, say about two-thirds of its width. The top end B stands at a distance of one-fourth of an inch, or nearly so, from the lower part of the breast, the distance increasing towards the extreme end, so as to remove all obstruction out of the way of the ascent of the fibres of cotton.

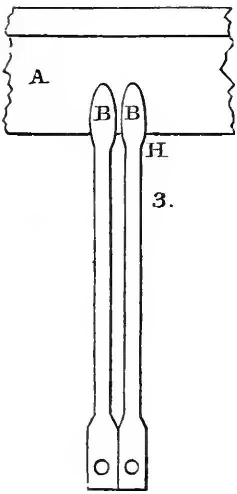
In the above described arrangement, the teeth of the saw pass be-

tween the ribs at a point above the branching off of the arm D, as shown in fig. 1, but I sometimes omit this arm and attach the rib in another manner to the front of the breast, in which case it may be constructed as shown in fig. 2, in which F is a piece extending above the point or upper end of the rib, through which it is screwed to the front of the breast, it being so formed as to sustain the end, B, of the rib at a distance from the breast, similar to the part B' in fig. 1. G is a wing or flat piece projecting out from the rib, and which is let into the breast; the whole of the said rib is above the saw, and the fibres pass freely up on either side of it and escape with the seed at the top. Although this mode of construction has been found to answer a good purpose, that first described is preferred.



2.

Fig. 3 shows the form which I give to the faces or outsides of the ribs, A being a portion of the breast or grate fall, with two of the ribs attached thereto; at the part H where the saw terminates, I widen them out as shown in the drawing, so as to narrow the space between them, and then again narrow them off towards the point, to aid in affording an unobstructed rise and escape of the fibres and seed.



3.

What I claim as my invention and improvement in constructing and affixing the ribs of saw gins for the ginning of cotton, is the so forming and affixing them to the breast or grate fall as that their upper ends shall stand off from the front of said breast in the manner herein described, in order to allow of a free and uninterrupted rise and escape of the fibres and seed from the upper ends of said ribs, and this I claim, whether the said ribs be formed and attached precisely in the manner set forth or in any other way which is substantially the same, and by which a like result is obtained.

Asa Copeland, Jr.

Specification of an Improved Power Loom, by which it is adapted to the weaving of Counterpanes. Granted to Erastus B. Bigelow, *Lancaster, Worcester county, Massachusetts, April 24th,* 1840.

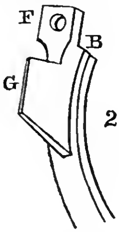
To all whom it may concern: Be it known that I, Erastus B. Bigelow, of Lancaster, in the county of Worcester, and state of Massachusetts, have invented a new and improved mode of constructing the power loom, by which improvement it is adapted to the weaving of figured counterpanes and to other articles of a similar character; and I do hereby declare that the following is a full and exact description thereof.

ˑ improvements consist principally in the manner in which the es are thrown; the manner of raising and depressing the shuttle ;, and the manner in which the picker is relieved from the shuttle. :hrowing the shuttles I cause the two picker staves to operate taneously, so that the shuttle may be thrown from whichever : boxes is presented to their action. This is effected by the use of icker treadle only, which is acted upon by a cam ball, in the usual of working such treadles. From this treadle two bands are ex- d, and pass around the two picker pulleys, in such manner that ι the treadle is depressed, both the picker staves will be set in ı at the same moment. By this arrangement two or more shut- ıay be successively thrown from the same end of the loom by the ı of one treadle.

e shuttle boxes are raised and lowered in the following manner. ıft extends along under the race beam, from one shuttle box to ther, and carries pinions which take into racks attached to the le boxes; it will be manifest, therefore, that by causing this shaft ·olve, the shuttle boxes may be raised. The revolving of this is effected by the action of a spiral, or other, spring, one end ıich is attached to the frame of the loom at its back, and said g extends forwards towards the lathe; from this forward end a , attached to it, passes around guide pulleys, and also around a y upon the above named shaft, to which latter the said band is hed. The action of the spring, by its drawing upon the band, :ause the pinion shaft to revolve, and will consequently raise the le boxes. Should this spring be thrown out of action, and the by which the shuttle boxes are raised be relaxed, they will then :nd by their own gravity. To take off the tension of the spring is a cam upon the main shaft of the loom, which cam, as the revolves, depresses a treadle, to the end of which a band is at- :d which operates in such a way as to relieve the shuttle boxes the action of the spring, and they then descend.

relieving the picker from the point of the shuttle, I make use of ›rotection rod constituting a part of the apparatus employed in the ıary power loom for stopping the loom when the shuttle does not e home in the shuttle box. From the protection rod, which ex- ; along below the shuttle boxes, I allow a small arm, or finger, escend, which finger, as the lathe comes up towards the breast ı, strikes against a stop, or pin, attached for that purpose to the .e of the loom, causing the protection rod to rock or revolve to a t distance. This gives motion to two arms which extend out from :xtreme ends of the protection rod, opposite to the outer ends of of the shuttle boxes; from these arms motion is communicated to ·er which works on a fulcrum over the outer ends of each of the tle boxes, said arms being connected to the levers by rods, or wires. lepressing the outer ends of these levers their inner ends are rais- ınd to these ends are appended rods which carry pieces of wood ıetal which when down rest on and embrace the picker rod, and ıat position they serve to hold the picker at a short distance from end of the shuttle box, and to stop the shuttle; the picker is then

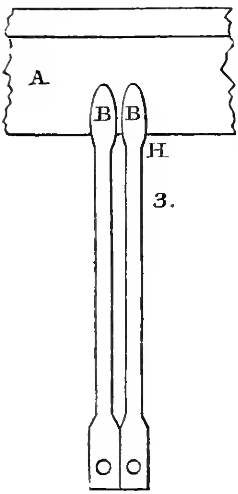
tween the ribs at a point above the branching off of the arm shown in fig. 1, but I sometimes omit this arm and attach the another manner to the front of the breast, in which case it m constructed as shown in fig. 2, in which F is a piece extending



2.

the point or upper end of the rib, through whicl screwed to the front of the breast, it being so form to sustain the end, B, of the rib at a distance froi breast, similar to the part B′ in fig. 1. G is a w flat piece projecting out from the rib, and which into the breast; the whole of the said rib is abov saw, and the fibres pass freely up on either side of escape with the seed at the top. Although this m construction has been found to answer a good pu that first described is preferred.

Fig. 3 shows the form which I give to the faces or outsides c



3.

ribs, A being a portion of the breast or fall, with two of the ribs attached theret the part H where the saw terminates, I them out as shown in the drawing, so narrow the space between them, and again narrow them off towards the poi aid in affording an unobstructed rise an cape of the fibres and seed.

What I claim as my invention and imp ment in constructing and affixing the ri saw gins for the ginning of cotton, is tl forming and affixing them to the bre grate fall as that their upper ends shall off from the front of said breast in the m herein described, in order to allow of a and uninterrupted rise and escape of the and seed from the upper ends of said ribs this I claim, whether the said ribs be fo and attached precisely in the manner set or in any other way which is substantially the same, and by v a like result is obtained.

Asa Copeland,

Specification of an Improved Power Loom, by which it is ad to the weaving of Counterpanes. Granted to Erastus B. I low, *Lancaster, Worcester county, Massachusetts, April* 1840.

To all whom it may concern: Be it known that I, Erastus B. low, of Lancaster, in the county of Worcester, and state of M chusetts, have invented a new and improved mode of constructin power loom, by which improvement it is adapted to the weavir figured counterpanes and to other articles of a similar character: I do hereby declare that the following is a full and exact descri thereof.

My improvements consist principally in the manner in which the shuttles are thrown; the manner of raising and depressing the shuttle boxes, and the manner in which the picker is relieved from the shuttle.

In throwing the shuttles I cause the two picker staves to operate simultaneously, so that the shuttle may be thrown from whichever of the boxes is presented to their action. This is effected by the use of one picker treadle only, which is acted upon by a cam ball, in the usual way of working such treadles. From this treadle two bands are extended, and pass around the two picker pulleys, in such manner that when the treadle is depressed, both the picker staves will be set in action at the same moment. By this arrangement two or more shuttles may be successively thrown from the same end of the loom by the action of one treadle.

The shuttle boxes are raised and lowered in the following manner. A shaft extends along under the race beam, from one shuttle box to the other, and carries pinions which take into racks attached to the shuttle boxes; it will be manifest, therefore, that by causing this shaft to revolve, the shuttle boxes may be raised. The revolving of this shaft is effected by the action of a spiral, or other, spring, one end of which is attached to the frame of the loom at its back, and said spring extends forwards towards the lathe; from this forward end a band, attached to it, passes around guide pulleys, and also around a pulley upon the above named shaft, to which latter the said band is attached. The action of the spring, by its drawing upon the band, will cause the pinion shaft to revolve, and will consequently raise the shuttle boxes. Should this spring be thrown out of action, and the band by which the shuttle boxes are raised be relaxed, they will then descend by their own gravity. To take off the tension of the spring there is a cam upon the main shaft of the loom, which cam, as the shaft revolves, depresses a treadle, to the end of which a band is attached which operates in such a way as to relieve the shuttle boxes from the action of the spring, and they then descend.

In relieving the picker from the point of the shuttle, I make use of the protection rod constituting a part of the apparatus employed in the ordinary power loom for stopping the loom when the shuttle does not arrive home in the shuttle box. From the protection rod, which extends along below the shuttle boxes, I allow a small arm, or finger, to descend, which finger, as the lathe comes up towards the breast beam, strikes against a stop, or pin, attached for that purpose to the frame of the loom, causing the protection rod to rock or revolve to a short distance. This gives motion to two arms which extend out from the extreme ends of the protection rod, opposite to the outer ends of each of the shuttle boxes; from these arms motion is communicated to a lever which works on a fulcrum over the outer ends of each of the shuttle boxes, said arms being connected to the levers by rods, or wires. By depressing the outer ends of these levers their inner ends are raised, and to these ends are appended rods which carry pieces of wood or metal which when down rest on and embrace the picker rod, and in that position they serve to hold the picker at a short distance from the end of the shuttle box, and to stop the shuttle; the picker is then

removed from the point of the shuttle by the raising of the lever, the picker being made to pass home to the end of the box, thus leaving the shuttle and shuttle box free to be raised or lowered without obstruction, the picker being also ready again to act on a shuttle. The picker is removed from the point of the shuttle, after the block has been raised by a rod, actuated by a spring, which rod is connected with the picker stave by a cord, in order that the stave may, by its motion, move the rod, also that it may not impede the motion of the picker.

Having thus fully described the nature of my improvements, and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is, first, the manner in which the picker staves are operated upon by a single treadle so as to act simultaneously, whereby two or more shuttles may be thrown successively from the same shuttle box, if required; the apparatus therefor being constructed substantially as set forth. Secondly, I claim the raising the shuttle boxes by the action of a spring, or springs, weight, or weights, and the allowing them to descend by their own gravity when the tension of the spring, or the force of the weights, is taken off; the same being effected in the manner described, or in any other analogous thereto. Thirdly, I claim the relieving of the shuttle from the picker, by means of an apparatus constructed and operating as herein described, that is to say, by the combined action of the levers, the pieces of wood or metal, and the rods, connected by cords to the picker stave, connected and operating substantially as described.* ERASTUS B. BIGELOW.

Specification of a Patent for an improvement in the art of Tanning. Granted to RICHARD T. DOWNING *and* GEORGE D. SMITH, *of the city of Philadelphia, April 30th,* 1840.

To all to whom these presents shall come: Be it known that we, Richard T. Downing and George D. Smith, of the city of Philadelphia and state of Pennsylvania, have invented a new and useful improvement in the art of tanning, and that the following is a full and exact description of our said invention and of the manner and process of making, constructing and using the same.

In the process of tanning leather by suspending hides in liquor, on what is termed Brown's Patent Reels, or any other mode of suspending or immersing the hides in liquor, it has been found impossible to produce thereby a durable color, or bloom, as is produced by handling leather up and down in liquor, at first, and subsequently by laying away in liquor with a stratum of bark between each hide or half hide. In consequence of this apparent deficiency in the system of tanning by suspending hides in liquor until they are tanned, the most approved tanners of that class have had to resort to the expedient of laying away their leather in vats suitable for the purpose with strata of bark between, as before described, thus incurring additional expense and loss of time.

* In the original there are drawings, with references thereto.

Now it has been discovered, by the applicants, that immediately upon the suspension of the hides in the liquor, a sediment commences to collect upon the grain, or surface, of the hide, and to adhere to it so firmly as to prevent the natural action of the bleaching, or blooming, properties of most bark and other liquors containing the tannin principle, upon the removal of which obstruction the liquor acts upon the hide so as to form the most perfect and uniform color and bloom, similar, or superior, to that which is obtained by means of laying away with bark as aforesaid.

The removal of this sediment also facilitates the operation of tanning, and increases the pliableness of the leather. For this purpose we have constructed a cleansing brush made by the insertion of stiff bristles, say from three to four inches long, (depending on the space between the hides) on each side of a board from one to one and a half inch thick, six to ten inches wide and eighteen to twenty-four inches long, made in the form of a paddle, with a handle about seven feet long. This brush is furnished with bristles all around it. When used, this brush is placed between two sides suspended as aforesaid, and placed grain to grain, and worked up and down by hand, by which the sediment is prevented from collecting on the surface of the leather.

What we claim as our invention or discovery is an improvement in the art or process of tanning by cleansing the hides whilst suspended in bark or other liquor containing the tannin principle, by means of a brush with a long handle, made and used as above set forth, in order to prevent the collection of any sediment, dirt or impurity upon the surface, or grain, of the leather, and thus to allow the liquor to act, to produce gradually the commencement of the process, the desirable color, or bloom, and giving the tannin a free access through the pores to unite with the gelatine of the hide.

RICHARD T. DOWNING,
GEORGE D. SMITH.

Proceedings in an Appeal from the decision of the Commissioner of Patents, HENRY L. ELLSWORTH, ESQ., *rejecting the application of* JOHN F. KEMPER, ESQ., *of Cincinnati, Ohio, for a Patent for an Improvement in the Manner of Stowing Ice.*

[CONCLUDED FROM PAGE 359.]

Opinion of the Chief Justice.

The petition of John F. Kemper sets forth that he "has *invented* certain *improvements* in the manner of constructing vessels for the stowing and carrying ice; and also *an improvement in the manner of stowing the same;* and prays that letters patent of the United States may be granted to him *therefor*, securing to him and his legal representatives an exclusive right in and to his said invention agreeably to the provisions of the acts of Congress in that case made and provided; he having paid thirty dollars into the Treasury of the United States, and otherwise complied with the requirements of the said acts."

In his specification, after describing his vessel and the improvements in the same, and certain matters to be attended to in the stowing of the ice, he says:

"I have discovered that for the purpose of keeping ice for a great length of time it is necessary in stowing it, to place all the pieces edgewise, as, when placed flatwise, small openings are formed through it by the percolation of water or otherwise, and that this injurious effect goes on increasing, and eventually producing a rapid destruction thereof; this I obviate by carefully packing all the blocks edgewise, when, as experience has abundantly shown, no such effect is produced. This mode of stowage applies not only to vessels, but also to ice houses, and whenever ice is to be preserved."

After stating what he disclaims, and what he claims as his invention and improvements in constructing vessels for the transportation of ice, he says:

"In the manner of stowing the ice I claim the placing of the prepared blocks edgewise, in the manner and for the beneficial purpose herein set forth."

No objection was made by the Commissioner of Patents to the grant of a patent for the novel construction of vessels for the transportation of ice, as claimed by him; but the Commissioner decided that the applicant was not entitled to receive a patent for the manner of stowing the ice by placing the blocks edgewise.

From this decision he has appealed according to the provisions of the 11th section of the act of March 3d, 1839, and the 7th section of the act of July 4th, 1836; and has filed in the patent office his reasons of appeal, and paid the sum of twenty-five dollars to the credit of the patent fund.

By the 11th section of the act of March 3d, 1839, ch. 88, (pamphlet edition) the Judge is to confine his revision to the points involved in the *reasons of appeal;* and the Commissioner of patents is to lay before the Judge, the grounds of his decision touching the same point.

The applicant claims a patent for his vessel, and his manner of stowing ice in vessels and ice houses, as one invention, and pays thirty dollars as for one patent.

The Commissioner denies his right to a patent for his manner of stowing, but admits it for his improvement in the construction of his vessel.

The first and principal point involved in the reasons of appeal, is whether the thing for which the patent is claimed is the invention or discovery of a new and useful art, or of a new improvement on an art, within the meaning of the Constitution and laws of the United States respecting patents.

The invention, if it be one, consists only in laying each block of ice on its narrowest side. Can that act be considered as a new thing invented or made? Was it never done before? If it has been done before, although the *beneficial effect* of so placing it, rather than on its broadest side, had not been discovered, it is not a new thing. The only thing new is the discovery of the beneficial effect—and that is the discovery of a thing which existed before, for if it is now true that ice so placed keeps longer than when differently placed, it was always true—and that it existed before is shown in the specification where it is said that the effect was discovered by *experience.*

Much of the confusion of ideas upon this subject has arisen from the ambiguity of the words "*discover*" and "*discovery*" used in the Constitution and the patent laws of the United States. In their primary and common sense they are not synonimous with "*invent*" and "*invention.*"

Webster, in the last 8vo. edition of his dictionary, under the word "*discover,*" says, "*discover* differs from *invent.* We *discover* what *before existed.* We *invent* what did *not before exist.*" And under the article "*invention*" he says, "*invention* differs from *discovery*, invention is applied to the contrivance and production of something that did not before exist. *Discovery* brings to light that which *existed before*, but which was not known."

A discovery, in this sense, is not the subject of a patent; and it will be found, by a careful perusal of the Constitution and Laws of the United States upon the subject of patents for useful arts, &c., that it is not there used in this sense but always as synonimous with *invention.*

Thus the Constitution (in ch. 4, art. 1, sec. 8, clause 8,) among the enumerated powers given to Congress, says—"To promote the progress of science and useful arts, by securing, for limited times, to authors and *inventors* the exclusive right to their respective writings and *discoveries.*"

Here it is evident that the "*discoveries,*" the use of which is to be secured, are the discoveries of *inventors* only. The applicant must invent, contrive, or produce something that did not exist before. A man may *discover* (i. e. may disclose) his *invention;* and for that discovery or disclosure he will be entitled to the exclusive use of his *invention* for a limited time.

In the first act of Congress "to promote the progress of useful arts," passed April 10, 1790, the words *invention* and *discovery* are used synonimously throughout the whole act; and whether application was for a patent, for an invention, or a discovery, it must be founded upon an invention or discovery of an useful art, &c., (or improvement therein,) not before known or used. The discovery of a new art, that will justify a patent under that act can be only the *invention* of a new art, and the discovery of a new improvement the *invention* of a new improvement. In every case, therefore, the applicant must be the inventor; and by the Constitution none but *inventors* could be entitled to the monopoly.

The next act was passed on the 21st of February, 1793, entitled "an act to promote the progress of useful arts; and to repeal the act heretofore made for that purpose."

By the first section of this act, the applicant was to declare that he had *invented*, not discovered, a new and useful art, &c., or improvement, &c., and the patent was to give a short description of the said invention or *discovery*. Here "*discovery*" is intended to be synonimous with invention, for the claimant had alleged an *invention only;* and it is afterwards again, in the same section, called, the said invention or *discovery*. The second section says that any person who shall have *discovered* an improvement and obtained a patent therefor shall

not be at liberty to use "the original *discovery*, nor shall the first *inventor* (i. e. of the *original discovery*, which he had alleged to be his *invention*,) be at liberty to use the improvement." And a change of form or proportions, was not to be "deemed a *discovery*." By the third section every *inventor* was to swear or affirm that he believed that he was "the true inventor or *discoverer* of the art," &c., and deliver a written description of his *invention*, by which it may be distinguished from other *inventions*.

The fourth and fifth sections speak of *inventors* and *inventions* without saying any thing of discoverers, or discoveries.

The sixth section, alluding to the same *invention*, calls it "his *discovery*," and speaks of *original discovery*, and *supposed discovery*, and the *discovery of another man*, and all these expressions are used in reference to what had been patented as *inventions*. The tenth section speaks of the *true inventor or discoverer*, and the eleventh section provides that every *inventor* shall pay thirty dollars before he presents his petition.

The act of the 17th of April, 1800, only extends the privileges of the former act to aliens and to the legal representatives of *inventors* and *discoverers*, &c., and gives treble damages for violation of patent rights.

The act of July 13th, 1832, applies only to aliens.

The next act is that of July 4th, 1836, entitled "an act to promote the progress of useful arts, and to repeal all acts and parts of acts heretofore made for that purpose."

The first section speaks of "issuing patents for new and useful *discoveries, inventions and improvements*," as part of the business of the Commissioner of Patents whose office was therein created.

In the fifth section the words *invention* and *discovery* as used throughout are synonimous.

The sixth section, which declares for what a patent may issue, shows that the applicant must have "*discovered* or *invented* some *new* art, &c., or improvement, and it is called "his discovery or invention thereof," and he is called the *inventor* or *discoverer*. It then says, "but before any *inventor* shall receive a patent for any such new *invention* or *discovery*, he shall deliver a written description of his *invention* or *discovery*. The descriptions and drawings are to be signed by the *inventor*, and he is to furnish a model of his *invention*, and he is to make oath that he does verily believe that he is the original and first *inventor* or *discoverer* of the art, &c., or improvement, for which he solicits a patent; and that he does not know or believe that *the same* was ever before known or used."

In the seventh section wherever the word *discovery* or *discoverer* is coupled with invention or inventor, it is evident that it means the discovery or discoverer of something *new*, something that did not exist before, and therefore equivalent to *invention* and *inventor*. In the latter part of the section it speaks of the science to which the alleged *invention* appertains, and of the part, or parts, of the *invention* which he, the Commissioner, considers as not entitled to be patented.

The eighth section speaks of the right of an *original and true in-*

ventor to a patent for his *invention*, and says nothing of a *discovery* or *discoverer*.

The twelfth section speaks only of *invention* not discovery, yet it is evidently applicable to the former sections which use the words *invention* or *discovery*.

The thirteenth section provides that where a patent shall be "invalid by reason of the patentee claiming in his specification, as his own *invention*, more than he had a right to claim *as new*, the Commissioner may cause a new patent to be issued to the said *inventor* for the same *invention*, &c. The same section afterwards speaks of a "description and specification of any new improvement of the original *invention* or *discovery* which shall have been *invented* or *discovered by him*, the patentee, subsequent to the date of his patent."

The fifteenth section specifies the special matter which may be given in evidence by the Defendent under the general issue, among which is evidence tending to prove that the description and specification filed by the Plaintiff does not contain the whole truth relative to his *invention* or *discovery*, or that the patentee was not the original and first *inventor* or *discoverer* of the *thing* patented, or of a substantial and material part thereof claimed *as new;* or that he had surreptitiously, or unjustly, obtained the patent for that which was, in fact, *invented* or *discovered* by another. It also speaks of "the *invention* or *discovery* for which the patent issued." It speaks also of the first *inventor* without adding *discoverer;* and of the *invention* without adding *discovery*.

The sixteenth section speaks of the *invention* patented, and generally of *inventions* without adding discoveries.

The seventeenth section speaks of injunctions to prevent the violation of the rights of any *inventor*, but says nothing of any *discoverer*, shewing that the word *inventor* included all such *discoverers* as were contemplated by the Legislature as within the protection of the *patent laws*.

The eighteenth section provides "that whenever the patentee of an *invention* or *discovery* shall desire to extend his patent beyond the term of its limitation, he may make application," &c., and shall furnish a statement of "the ascertained value of the *invention*," and having failed to obtain from the use and sale of *his invention*, a reasonable remuneration, &c., he may have the term extended. Here it is evident that the word *invention* was understood as equivalent to *invention and discovery*, mentioned in the beginning of the section; and shows that the discovery contemplated was the discovery of something *new*—i. e. that did not exist before, and was used as synonimous with the word *invention*.

The remaining sections of the act do not use the word *invention* or *discovery*.

The act of March 3, 1839, (Pamphlet, ch. 88, p. 74,) section seventh, says that every person who shall have constructed any "newly *invented* machine, manufacture, or composition of matter prior to the application by the *inventor* or *dicoverer* for a patent, shall be held to possess the right to use, &c., the specific machine, &c., so made, &c.,

without liability therefor to the *inventor* or any other person interested in such *invention;* and no patent shall be held to be invalid by reason of such use, &c., except on proof of abandonment of such *invention* to the public," &c.

There is nothing further in this act tending to explain the meaning of the word *discovery* as used in the Constitution and Laws of the United States respecting patents for useful arts.

Upon consideration of the Constitution and Laws of the United States upon this subject, therefore, I think I may safely say, that the claimant in this case can build no argument upon the supposed difference between a discovery and an invention; for no discovery will entitle the discoverer to a patent which does not, in effect, amount to the contrivance or production of something which did not exist before, or in other words to an invention.

The patent claimed is *for the placing of the prepared blocks edgewise,* for the purpose set forth in the specification.

The placing of the blocks of ice edgewise, is not the contrivance or production of any thing which did not exist before. It is not an invention. It is not a discovery, because every body knew before that the blocks of ice might be placed upon their narrowest side; and it is asserted by the Commissioner in the grounds of his decision, and not denied in argument, that blocks of ice have been so placed; whether by accident or design is immaterial; the placing is not new. It is not an invention.

The discovery of a new effect of that which existed before is not the subject of a patent. Blocks of ice have been placed on edge before the alleged discovery by the claimant. If they were so placed with intent to retard their dissolution, I presume the claimant would at once abandon his claim. But the intent can be no ground of a patent. The claimant may be the first who placed blocks of ice on edge *with that intent,* but this cannot justify a patent for doing that which was often done without that intent. In truth the whole merit of the claimant is the discovery of a fact which existed long before, viz. that ice placed edgewise kept longer than when placed flatwise. This is a mere naked *discovery,* for which a patent cannot be granted. There is no invention, nothing contrived or produced which did not exist before.

It is, however, contended that although the discovery, merely as such, is not patentable, and although blocks of ice may have been often placed edgewise, yet "it will not be pretended that in vessels or in ice-houses ice had ever been stowed away upon the *system* adopted by Mr. Kemper." By "*system*" I suppose must here be meant *intent* or purpose—for the placing the ice on edge cannot, of itself, form a system. A system, as defined by Dr. Johnson, is "any complex use, or combination of many things acting together; a scheme which reduces many things to regular dependence or co-operation; a scheme which unites many things in order."

The patent, in the present case, is not asked for a *system,* but for the exclusive right to place blocks of ice on their narrowest side. The claim, therefore, obtains no support by calling it a *system;* nor

by calling it a "*plan*," as in the reasons of appeal, where it is asked, "Is the proposed *plan* unquestionably old?" What the writer meant by the word *plan* is not very obvious, but I presume he intended to refer to the placing of the ice *edgewise, with the intent* that it should thereby keep longer than if otherwise placed. He probably meant to include the *intent* with the *act;* but as before observed, if the thing done be not new, the intent cannot entitle it to a patent.

It is admitted in argument on behalf of the applicant, "that a discovery, taken abstractedly, is not patentable;" but it is contended "that if the thing discovered be practically applied to produce a new and useful effect, the manner of obtaining this end is patentable." Now let us apply this rule, or doctrine, to the present case. The thing discovered is the beneficial *effect* of the position of the ice—not the position itself. How is this *effect*, which is the thing discovered, applied by the applicant to produce a new and useful effect? and what is the new effect thus to be produced by the effect discovered? Whatever it may be, it must be produced by means that are new—by some *invention*—some contrivance or production of something that did not before exist. The beneficial effect of the position of the ice, is the retardation of its dissolution. No new and further effect is proposed. That retardation is the *ultimate* effect contemplated. No *new* means are intended to be used which can be the subject of a patent. A new effect from old means will not justify a patent for those old means. This case is, therefore, not within the rule or doctrine thus advanced to support it.

The patent to Mr. Tudor for filling the interstices between the blocks of ice with some non-conducting substance, is cited as a precedent for the present application. No judicial decision is produced affirming the validity of that patent, and it seems to me to rest upon very doubtful grounds; but it is to be presumed that the Commissioner who issued it, was satisfied that the means used were a new invention.

Mr. Dolland's patent for an improvement is also referred to, but there the means used were decided to be, as to him, a new invention, although Dr. Hall had, forty years before, constructed two telescopes upon *the same principle*, but had not pursued the matter and brought it into public use. That case has no analogy to the present.

In the reasons of appeal it is suggested that patents for *processes*, or *modes of procedure*, in preserving animal and vegetable substances by means extremely simple, have been granted in England and in this country; but as they are not particularly brought to my notice, I cannot say how far they may be considered as precedents to justify the present application. I presume that in all of them something new was invented; something more than the discovery of a fact or a principle, and the application of such fact or principle to some useful purpose by old means, or by means not newly invented.

It is also suggested in the reasons of appeal, that "the Commissioner is *bound* to issue a patent for the thing claimed, if on examination it shall not appear to him that the same had been invented or discovered by any other person in the country, prior to the alleged in-

vention or discovery thereof by the applicant, or that it had been patented or described, &c., as stated in the seventh section of the act of July 4, 1836; and that the *discovery* in question is not placed in either of the conditions that would justify the refusing of a patent, under the law.

But the seventh section refers to the sixth, by which it appears that a patent is to be issued only to a person who has discovered or invented some *new* and useful art, &c., or some *new* and useful improvement on any art, &c.

The Commissioner, therefore, is to decide in the first place, whether the invention is new, and whether it is the proper subject of a patent; and if he finds that it is not the proper subject of a patent, he is bound to refuse it, although it may not be liable to the particular objections specified in the seventh section.

It is also said in the reasons of appeal, that the professed rule of the office is "that where the question is at all doubtful, that a patent should be granted."

This rule, I suppose, must have been adopted when the applicant had no remedy if the Commissioner rejected his claim, and the decision of the Commissioner was affirmed by the Board of Examiners, under the seventh and sixteenth sections of the act of July 4, 1836—which last mentioned section gave the applicant a remedy by bill in equity, only in case the patent was refused on the ground that it would interfere with an unexpired patent previously granted. In all other cases of refusal, the applicant had no remedy—whereas, if the patent should be granted, its validity might be at all times questioned in the courts of law. It was reasonable, therefore, to adopt such a rule.

But now, by the tenth section of the act of March 3, 1839, if the patent be refused, for any cause, either by the Commissioner or the Judge, the applicant may still establish his right to a patent by a bill in equity.

The reason of the rule therefore fails, and I should not think myself bound by it if I thought this to be a case of doubt, which I do not.

Every patent is a monopoly, and nothing can justify it but the natural right of property which a man has in the products of his own labor and ingenuity. With this exception, it is in derogation of common right; and it should be strictly confined to the case excepted. Upon the whole, therefore, I am of opinion, and so decide, That the decision of the Commissioner of Patents, that the applicant, John F. Kemper, was not entitled to receive a patent for the manner of stowing ice by placing the blocks edgewise, was correct, and the same is hereby confirmed.

And I do hereby certify the same to the said Commissioner of Patents; and I further certify that having received an appeal and the petition herewith inclosed, of John F. Kemper, and the original papers named in the letter from the Commissioner of Patents of the 13th of February, 1841, herewith also inclosed, I ordered notice to be given, as appears in my order of the 17th of February, 1841, also herewith inclosed, which was returned to me on the 18th of Febru-

ary, 1841, with service acknowledged. I further certify that the parties appeared before me, at my chambers, on Monday, the 8th of March, 1841, when, by consent, the hearing was postponed to Monday, the 15th of March, when the applicant, by Dr. Thomas P. Jones, his Attorney, presented his written answer to the grounds of the Commissioner's decision, (which written answer is also herewith inclosed,) when the hearing was further postponed, by consent, to Wednesday, the 17th instant, and on that day further postponed until Friday, the 19th instant, when the parties attended, and the Commissioner filed his reply to the argument of Doctor Jones, which is also herewith inclosed, and the case was then submitted, without further argument. All which papers are herewith transmitted to the Commissioner of Patents, this 22nd day of March, 1841.

W. Cranch.

Cast-Iron Tiles.

The *Memorial de la Sambre* announces that a trial has just been made in the manufactories of Gougnies, to substitute plates of cast-iron for slates and tiles. In these first specimens seventeen plates of cast-iron of a certain shape cover a square metre, and this square metre weighs on an average twenty-two kilogrammes. The same extent covered by common slates weighs twenty-one kilogrammes, and by large slates nineteen kilogrammes, and the square metre of tiles weighs forty kilogrammes. Thus, on the ground of lightness alone, cast iron plates may bear competition with slates, and they have a decided superiority over tiles. The plates of cast-iron are sold at the establishment of Gougnies at thirty centimes a piece; two centimes more when they are required to be varnished, to protect them from the wet. The value of the plates, therefore, is five francs ten centimes the square metre, and varnished plates five francs forty-four centimes. The price of these cast-iron plates is therefore not exorbitant, particularly when it is considered that the use of plates of cast-iron prevents the annual expense of repairing, which in roofs of slate or tiles average a quarter, and sometimes a third, of the first cost. Besides, there is a saving of the nails which are used to join the slates. The iron plates are fixed merely by wooden laths. It is expected that this new invention will be of great service to the iron manufacturers; many other applications of iron it is expected will result from this.

Mining Review, Dec. 1840.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JUNE, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	12	0	Im. (282) Solitarii,	6	36°	57°
1	13	7	Em.		292	325
2	8	29	Im. π Scorpii,	3.4	75	46
2	9	52	Em.		241	225
2	14	50	Im. *m* Scorpii,	6	148	187
2	15	26	Em.		207	251
4			Im. *p* Sagittarii, 5 below the horizon			
4	9	14	Em.		283	244
JULY, 1841.						
5	11	18	Im. 21 Capricorni,	6	165	134
5	12	17	Em.		247	225
5	14	58	Im. θ Capricorni,	5.6	70	83
5	15	47	Em.		359	22
16			Im. ι Geminorum,	*invisible.*		
16	15	54	Em.		295	246
28	11	53	Im. *y* Ophiuchi,	6	44	82
28	12	38	Em.		333	14
29	12	45	Im. *g* Sagittarii,	5.6	175	209
29	13	19	Em.		226	265
31	12	37	Im. 351 Sagittarii,	6	31	48
31	12	42	Em.		24	43

Meteorological Observations for April, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches	
	1	41	55	29.85	29.85	S.W.	Moderate.	.03	Cloudy—rain—clear.
	2	43	68	.80	.65	SE S.	do.	.12	Lightly cloudy—do. do.—tornado
	3	38	50	.94	30 05	W.	do.		Clear—do
☺	4	36	47	30.10	.00	SE.	do.		Cloudy—do.
	5	45	55	29.6[illegible]	29 74	W.	Brisk.		Cloudy—clear.
	6	44	54	.95	30 01	W.	do.		Cloudy—clear.
	7	45	57	30.10	29.90	W.SE.	Calm.		Cloudy—do.
	8	41	55	29.70	75	NE.	Moderate.	.05	Drizzle—flying clouds.
	9	45	68	.8[illegible]	.60	S.	Brisk.		Cloudy—lightly cloudy.
	10	42	42	.70	.76	E.	do.	.23	Cloudy—snow.
	11	28	38	30 0[illegible]	30 10	E.	Moderate.		Clear--do.
☽	12	32	32	.10	.00	E.	Brisk.	1.00	Snow—do.
	13	30	46	29.85	29.85	NW.	Moderate.		Cloudy—flying clouds.
	14	33	47	.75	95	E.W.	do.	.75	Snow—flying clouds.
	15	30	47	30 27	30.35	W.	do.		Clear—do.
	16	30	56	.40	.41	SW.	do.		Clear—do.
	17	45	58	.10	.00	SW.	do.	.03	Drizzle—do—rain in night.
	18	58	58	29.50	29.60	SW.W.	Brisk.	.04	Cloudy—flying clouds.
	19	34	56	30.00	30.0[illegible]	W.	Moderate.		Clear—do.
	20	41	50	.[illegible]0	.00	SW.S.	do.	.22	Cloudy—rain.
⊗	21	48	55	29 85	29.84	NW	do.		Clear—do.
	22	41	4[illegible]	30 0[illegible]	30 00	NE.	Brisk.		Partially cloudy—cloudy.
	23	47	56	29.8[illegible]	29 90	NE SE.	do.	.35	Drizzle—rain—cloudy.
	24	49	62	.97	.97	E.	Moderate.		Cloudy—do.
	25	53	63	.97	30 0[illegible]	E.	do.		Cloudy—do.
	26	51	66	.90	29 84	E.S.	do.		Cloudy--clear.
☾	27	51	57	.56	.64	W.	do.	.36	Rain—clear.
	28	4[illegible]	63	.90	.91	NW.	do.		Clear--do.
	29	42	45	.80	.50	W.S.	do.	1.25	Partially cloudy—rain.
	30	44	52	.05	.05	W.	do.	.05	Cloudy—drizzle.
	Mean	41.63	53.57	29.88	29.83			4.49	

	Thermometer.		Barometer.	
Maximum height during the month,	68.00	on the 2nd and 9th.	30.41	on the 16th.
Minimum " "	28.00	" 11th.	29.05	" 30th.
Mean	47.60		29.88	

	Bar								Hygrometer.					
C	9, P. M.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1														
2	30.1⅔	3⅔	3⅓	3⅔	4⅔	⅓	.	.	....	.	....	....	.	1318
3														
4	30.0	4⅓	3	⅓	9⅓	.	.	⅔	....	.	....	....	.	1381
5														
6														
7	29.5	.	12⅔	.	3⅔	.	.	8	....	.	....	....	.	1352
8														
9														
10	28.1⅓	⅓	8	⅔	4½	.	.	.	....	.	....	....	.	1366
11														
12	29.3⅔	1⅓	5⅓	2	4	.	6⅓	⅔	....	.	....	....	.	1317
13	29.8	.	4⅔	2⅔	14⅓	.	⅓	.	....	.	....	....	.	1328
14														
15	29.5⅓	3⅓	⅓	2	13⅓	⅔	⅓	.	....	.	....	36.63	1	1324
16	29.4⅔	1⅓	8⅓	2	5	1	.	.	26.36	.	....	32.71	.	1334
17														
18														
19	29.8	.	4⅔	.	16⅔	.	.	.	....	.	....	....	.	1319
20	29.4	.	7⅔	⅓	3⅔	.	1⅓	.	....	.	....	....	.	1320
21														
22														
23														
24														
25														
26														
27	29.5⅓	.	1⅔	.	9⅔	.	10⅔	3⅔	....	.	....	....	.	1322
28														
29														
30	29.3	1⅓	6	1⅔	2	⅓	7	⅓	25.81	3	....	30.65	3	1374
31														
32	29.3	.	20⅔	.	.	.	.	⅔	....	.	....	....	.	1337
33	29.3	⅔	5	⅓	1⅓	.	.	20⅓	....	.	....	....	.	1325
34														
35	27.9⅓	.	3⅔	.	10	.	.	1	....	.	....	....	.	1335
36														
37	27.7	⅓	11⅓	⅓	7⅓	.	2⅔	1⅔	....	.	....	...	.	1323
38	29.1	7	⅓	6⅓	6⅔	.	.	1	....	.	.. .	....	.	1329
39	27.8⅔	⅔	11⅓	2	⅓	⅓	3⅔	1⅔	....	.	....	....	.	1326
40	28.5⅓	.	5⅔	.	1	.	8	.	....	.	...	....	.	1336
41														
42	28.7	.	⅔	.	5	.	4⅔	.	....	.	....	....	.	1332
43	28.9⅔	.	.	.	14⅓	.	.	1⅔	....	.	....	....	.	1333
44														
45														
46	29.0⅓	.	4⅓	.	8⅓	.	1	.	....	.	....	....	.	1441
47														
48														
49	29.2	⅓	3	.	7⅓	⅓	3⅔	1⅓	....	.	....	....	.	1339
50	29.3	.	3	.	12⅔	.	2	1⅓	....	.	....	....	.	1379
51	28.7⅔	.	5⅓	.	1⅓	.	.	.	....	.	....	....	.	1327
52														
53														

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA.
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

DECEMBER, 1840.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia. .	Philadelphia. .	G. P. Schively, .	26.92	35.66	29.98	48.00	16.00	30.85	.	16.00	24.97	.
2 Montgomery, .												
3 Bucks, .	Newtown, .	L. H. Parsons, .	25.13	35.13	27.32	47.25	10.00	29.19	.	10.00	22.30	.
4 Lehigh, .												
5 Northampton,	Easton, .	Charles Elliot, .										
6 Monroe .	Stroudsburg, .	A. M. Stokes, .	20.55	32.22	26.17	50.00	5.00	26.31	11⅔	5.00	9.71	24
7 Pike, .	Milford, .	Ralph Bull, .										
8 Wayne, .	Honesdale, .	W. Richardson, .										
9 Susquehanna.	Silver Lake, .	E. Rose, . .	17.00	23.33	19.45	37.00	1.00	19.93	.	1.00	15.87	.
10 Luzerne, .	Wilkesbarre, .	W. F. Dennis, .										
11 Schuylkill, .	Port Carbon .	P. C. Lyceum, .	22.83	35.95	25.10	48.50	6.00	27.96	⅔	6.00	18.58	.
12 Berks, .	Reading, .	C. F. Egelmann,	24.26	32.19	26.87	46.00	11.00	27.77	.	...	...	.
13 Chester, .	West Chester,	Wm. W. Jefferies, .										
14 Delaware, .	Haverford, .	Haverford School, .	25.82	32.41	29.04	49.00	13.00	29.09	3⅓	10.00	21.84	.
15 Lancaster, .	Lancaster, .	Conservatory of Arts,	24.19	35.56	27.60	49.00	12.50	29.12	.	11.00	20.97	.
16 York, .												
17 Lebanon, .												
18 Dauphin. .	Harrisburg, .	J. Heisely, .	27.51	32.23	30.42	43.00	20.00	30.05	.	17.00	25.23	.
19 Northumberland.	Northumberland,	Andrew C. Huston,	23.74	33.32	27.61	44.00	8.00	28.22	.	5.00	19.39	.
20 Columbia, .	Danville.	C. H. Frick.										
21 Bradford, .												
22 Tioga, .												
23 Lycoming, .												
24 Union. .												
25 Mifflin, .												
26 Juniata, .	Mifflintown, .	J. A. Rinkead, .	24.30	34.79	25.83	48.00	11.00	28.31	3⅓	....	....	.
27 Perry, .												
28 Cumberland. .	Carlisle, .	Prof. W. H. Allen,										
29 Adams, .	Gettysburg, .	Prof. M. Jacobs, .	22.54	34.05	26.71	47.00	8.00	27.76	.	8.00	20.13	.
30 Franklin, .												
31 Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	23.87	34.70	28.90	50.00	8.00	29.16	⅔	....	....	.
32 Centre, .	Bellefonte, .	John Harris, .	22.65	36.22	26.98	50.00	8.00	28.62	12⅔	....	....	.
33 Potter, .												
34 M'Kean, .	Smithport, .	Richard Chadwick,	19.81	28.64	21.64	42.00	—4.00	23.36	.	—7.00	18.10	.
35 Clearfield, .												
36 Cambria, .	Ebensburgh,	Richard Lewis, .	18.90	24.62	23.21	49.00	—3.00	22.24	1⅔	—3.00	17.50	3
37 Bedford, .	Bedford, .	Samuel Brown, .	24.27	34.09	27.34	55.00	10.00	28.57	1	....	....	.
38 Somerset, .	Somerset, .	George Mowry, .	24.77	31.95	27.14	50.00	4.50	27.95	1⅔	4.50	21.09	2
39 Indiana, .	Indiana, .	Richard White, .	27.77	32.68	25.42	50.00	12.00	28.62	.	....	....	.
40 Jefferson, .	Rose Cottage,	C. C. Gaskell, .										
41 Warren, .	Warren, .	C. S. Brown, .	29.95	35.19	33.26	49.00	10.00	32.80	.	10.00	29.32	.
42 Venango, .	Franklin, .	Wm. Connely, .	21.48	31.23	25.97	43.00	—2.00	26.23	.	....	....	.
43 Armstrong, .												
44 Westmoreland,												
45 Fayette, .	Uniontown, .	J. P. Weethee, .	27.22	35.58	29.10	56.00	7.00	30.63	.	....	....	.
46 Green, .												
47 Washington, .	Cannonsburg,	Prof. A. H. Campbell,										
48 Alleghany, .	Pittsburgh, .	J. P. Bakewell, .	30.77	35.69	31.97	55.00	9.00	32.81	⅔	....	....	.
49 Beaver, .	Beaver, .	James Allison, .	27.42	32.61	29.40	50.00	3.00	29.81	1⅓	....	....	.
50 Butler, .	Butler, .	Jacob Mechling, .	28.03	32.45	31.55	48.00	8.00	30.68	.	....	....	.
51 Mercer, .	West Greenfield,	S. Campbell, .										
52 Crawford, .	Meadville, .	J. Limber, .										
53 Erie, .	Erie, .	Park & Reid, .										

Barometer.

County.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.
1 Philadelphia	30.11	30.10	30.11	30.53	29.53	30.11	.
3 Bucks	30.03	30.02	30.03	30.47	29.46	30.03	.
6 Monroe	29.51	29.55	29.55	29.80	29.20	29.54	9⅔
9 Susquehanna	28.11	28.12	28.12	28.30	27.80	28.12	.
11 Schuylkill	29.35	29.36	29.37	29.73	28.79	29.36	⅔
12 Berks	29.83	29.84	29.83	30.30	29.22	29.83	.
14 Delaware	29.59	29.56	29.58	29.98	29.14	29.58	.
15 Lancaster	29.47	29.45	29.47	29.91	28.78	29.46	.
18 Dauphin	29.81	29.80	29.80	30.20	29.30	29.80	.
19 Northumberland	29.43	29.41	29.43	29.70	28.75	29.42	.
26 Juniata	29.52	29.53	29.54	30.00	28.87	29.53	3⅓
29 Adams	29.37	29.35	29.36	29.75	28.72	29.36	.
31 Huntingdon	29.33	29.31	29.32	29.76	28.66	29.32	⅔
32 Centre	29.30	29.25	29.30	29.71	28.71	29.28	11⅓
34 M'Kean	27.94	27.93	27.94	28.30	27.30	27.94	.
36 Cambria	27.74	27.77	27.73	28.14	27.07	27.75	1⅔
37 Bedford	29.19	29.17	29.19	29.55	28.50	29.18	1
38 Somerset	27.88	29.87	27.87	28.20	27.19	27.87	1⅔
39 Indiana	28.56	28.56	28.59	29.00	27.90	28.57	.
41 Warren	28.71	28.70	28.71	29.22	28.08	28.71	.
42 Venango	28.93	28.93	28.95	29.40	28.19	28.93	1⅔
45 Fayette	29.06	29.02	29.02	29.30	28.35	29.03	.
48 Alleghany	29.22	29.15	29.20	29.58	28.38	29.19	⅔
49 Beaver	29.39	29.37	29.38	29.80	28.60	29.38	1⅓
50 Butler	28.72	28.75	28.76	29.10	28.10	28.74	.

Weather.

County.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia	16	15	.	....	....	....	..	......
3 Bucks	14⅓	15⅓	1⅓	2	6	1	..	4.256
6 Monroe	5½	12⅓	13⅓	1	4	....	..	3.083
9 Susquehanna	10⅓	20⅔	.	2	9	....	..	......
11 Schuylkill	11	19⅓	⅔	1	11	....	..	2.328
12 Berks	11	20	.	3	6	....	..	3.843
14 Delaware	15	16	.	2	6	....	..	3.305
15 Lancaster	16⅔	14⅓	.	2	6	....	..	4.230
18 Dauphin	14	17	.	1	6	1	..	3.257
19 Northumberland	4⅔	26⅓	.	2	9	....	..	......
26 Juniata	8⅓	19	3⅔	....	....	....	..	......
29 Adams	14	17	.	....	....	....	..	.....
31 Huntingdon	9	22	.	1	8	....	..	1.522
32 Centre	4⅓	13	13⅔	....	....	....	..	......
34 M'Kean	4	27	.	1	8	1	..	2.301
36 Cambria	2	27⅓	1⅔	1	9	....	..	2.183
37 Bedford	8	22	1	1	5	....	..	......
38 Somerset	4⅓	24⅔	2	1	12	....	..	3.042
39 Indiana	3	28	.	6	7	....	..	1.460
41 Warren	5	26	.	....	....	....	..	......
42 Venango	4⅔	24	2⅓	....	7	....	..	1.832
45 Fayette	11⅔	19⅓	.	2	7	....	..	1.526
48 Alleghany	4⅔	26	⅓	3	6	....	..	1.965
49 Beaver	5	24⅔	1⅓	4	6	1	..	......
50 Butler	8	23	.	1	6	....	..	1.916

Winds. / Hygrometer.

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia	2⅔	1	2⅓	.	⅓	.	.	.	⅔	1⅔	6⅔	3⅔	3⅓	3⅔	4⅔	⅓	.	.	....	.	....	....	.	1318
3 Bucks	⅓	1⅓	3⅔	⅓	.	.	⅓	.	1	⅓	6	4⅓	3	⅓	9⅓	.	.	⅔	....	.	.....	....	.	1331
6 Monroe	1	.	1	.	2⅔	.	.	.	.	.	2	.	12⅔	.	3⅔	.	.	8	....	.	.....	....	.	1352
9 Susquehanna	8	.	.	.	.	.	.	.	4⅓	.	5⅓	⅓	8	⅔	4⅓	.	.	.	....	.	.....	....	.	1366
11 Schuylkill	1⅔	.	4⅔	⅓	.	⅓	⅔	.	.	.	3⅔	1⅓	5⅓	2	4	.	6⅓	⅔	....	.	.....	....	.	1317
12 Berks	⅓	.	2⅔	.	1¼	.	4	.	.	.	4	.	4⅔	2⅔	14⅓	.	⅓	.	....	.	......	....	.	1328
14 Delaware	⅓	2⅓	2⅓	1	.	½	⅔	⅓	.	⅓	3⅓	3⅓	⅓	2	13⅓	⅔	⅓	.	....	.	.....	36.63	1	1324
15 Lancaster	1⅔	⅔	3⅓	⅔	.	.	⅔	.	3	1⅓	1⅓	1⅓	8⅓	2	5	1	.	.	26.36	.	......	32.71	.	1334
18 Dauphin	1⅔	.	2⅔	.	1	.	3⅔	.	⅔	.	.	.	4⅔	.	16⅔	.	.	.	....	.	.....	....	.	1319
19 Northumberland	6	.	3⅓	.	2⅓	.	⅔	⅓	2⅓	.	3	.	7⅔	⅓	3⅔	.	1⅓	.	....	.	.....	....	.	1320
26 Juniata	.	.	5⅓	.	⅓	.	1⅓	.	.	.	⅓	.	1⅔	.	9⅔	.	10⅔	3⅔	....	.	.....	....	.	1322
29 Adams	⅓	1⅓	2⅓	.	⅔	.	⅓	.	3	⅓	4	1⅓	6	1⅔	2	⅓	7	½	25.81	3	.....	30.65	3	1374
31 Huntingdon	.	.	.	.	9⅔	.	.	.	.	.	.	.	20⅔	.	.	.	.	⅔	....	.	.....	....	.	1337
32 Centre	1	.	⅔	.	⅓	.	.	.	⅓	.	1	⅔	5	⅓	1⅓	.	.	20⅓	....	.	.....	....	.	1325
34 M'Kean	.	.	⅓	.	7⅓	.	⅓	.	.	.	3⅓	.	8⅔	.	10	.	.	1	....	.	.....	....	.	1335
36 Cambria	.	.	1⅓	.	2⅓	.	⅔	⅓	⅔	.	2	⅓	11⅓	⅓	7⅓	.	2⅔	1⅔	....	.	.....	...	.	1323
37 Bedford	.	2	.	.	.	.	⅔	1⅔	.	⅓	5	7	⅓	6⅓	6⅔	.	.	1	....	.	...	....	.	1329
38 Somerset	.	.	⅓	.	2⅔	⅓	.	⅓	1	.	4⅓	⅔	11⅓	2	⅓	⅓	3⅔	1⅔	....	.	.....	....	.	1326
39 Indiana	1⅓	.	.	.	.	.	1⅓	.	1⅓	.	12⅓	.	5⅔	.	1	.	8	.	....	.	...	....	.	1336
41 Warren	5	.	.	.	.	⅔	3	.	2	1	9	.	⅔	.	5	.	4⅔	.	....	.	.....	....	.	1332
42 Venango	.	.	.	.	.	.	9⅔	.	.	.	⅔	.	.	.	14⅓	.	.	1⅔	....	.	.....	....	.	1333
45 Fayette	.	.	2⅓	.	.	.	2⅓	.	⅓	.	12⅓	.	4⅓	.	8⅓	.	1	.	....	.	.....	....	.	1441
48 Alleghany	.	.	2⅓	⅓	2⅔	⅓	3⅓	.	3	.	3	⅓	3	.	7⅓	⅓	3⅔	1⅓	....	.	.....	....	.	1339
49 Beaver	⅔	.	2⅔	.	1	.	2⅓	.	1⅓	.	4	.	3	.	12⅔	.	2	1⅓	....	.	.....	....	.	1379
50 Butler	.	.	2	.	6⅓	.	⅓	.	.	.	15⅔	.	5⅓	.	1⅓	.	.	.	....	.	.....	....	.	1327

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